CONTEMPORARY ORTHODONTICS

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WILLIAM R. PROFFIT, D.D.S., Ph.D.

Professor and Chairman, Department of Orthodontics,
School of Dentistry, University of North Carolina,
Chapel Hill, North Carolina

with

HENRY W. FIELDS, Jr., D.D.S., M.S., M.S.D.

and

James L. Ackerman
Paul M. Thomas
J.F. Camilla Tulloch

With **1400** *illustrations*

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Preface

Contemporary Orthodontics has two purposes: (1) to provide a comprehensive overview of orthodontics at the present time, in a format useful to practitioners at all levels, including specialty practice; and (2) to serve as an orthodontic text for students of dentistry, providing the information necessary for a basic understanding of orthodontics in a logical and comprehensible format.

The two purposes are not incompatible, and indeed the authors hope that all parts of the book will be interesting and accessible to readers with highly varied backgrounds. There is, however, a considerable spectrum of material, extending from a review of basic principles to a discussion of clinical procedures that commonly are considered beyond the scope of general dental practice. Given the differing needs of readers at varying levels, it is all but impossible to survey the present theory and practice of orthodontics without including some material that is beyond readers who are beginners in dentistry. Other material already forms the basic background of successful practitioners.

In its chapters on clinical treatment procedures, this text is written to provide a broad overview of treatment possibilities and the principles on which various treatment methods are based. An attempt is made to provide information about various possible treatment methods, with an emphasis on fixed appliance treatment with the edgewise appliance but without endorsement of specific techniques within the edgewise system or exclusion of other possible treatment approaches. The material on treatment techniques perhaps can be described best as a background against which graduate-level discussions of specific treatment techniques could begin. The attempt is to summarize the present state of the art at a level useful to specialists but comprehensible and interesting to nonspecialists who wish an understanding of the objectives, possibilities, and general approaches to orthodontic treatment.

The book is arranged so as to facilitate its use in a curriculum that follows the guidelines for predoctoral orthodontics developed by the American Association of Dental Schools in 1978. These guidelines, which are included in current accreditation standards, suggest that an appropriate curriculum should include instruction at four levels:

1. Basic growth and development
2. Applied growth and development, including diagnostic procedures
3. Biomechanics and basic orthodontic techniques
4. Clinical orthodontics, including adjunctive procedures for adults and treatment procedures of limited complexity for children

Material relating to these educational objectives in this text is found as follows:

Basic growth and development—Chapters 2, 3, 4

Applied growth and development and diagnostic procedures—Chapters 1, 6, 7

Biomechanics, basic orthodontic techniques, and simpler clinical procedures—Chapters 9-14, 19

In addition, to the extent that this was practical, material within each section and chapter is arranged in a sequence of increasing complexity, so that for example, concepts introduced in the early part of Chapter 4 are appropriately included in an introductory growth and development course, whereas material covered toward the end of that chapter

often is reserved for an advanced-graduate level course. We hope that when the book is used as an orthodontic text, instructors will be able to easily identify and employ appropriate sections in conjunction with their preferred sequence and content of material.

Supplemental audiovisual materials to complement the sections of this text that normally are included in a predoctoral curriculum are available. These consist of a series of slide-tape sequences and video cassettes, along with teaching manuals. The instructional materials are grouped into four categories:

1. Basic growth and development: This is a complete self-instructional unit, including 8 video cassettes, 15 slide-tape sequences, a syllabus indicating the sequence and use of the instructional materials, and multiple-choice tests.
2. Applied growth and development: This also is a complete self-instructional unit, with 9 slide-tape sequences, 4 video cassettes, a syllabus, and test materials.
3. Biomechanics and laboratory technique: This consists of a laboratory manual and a series of video cassettes illustrating the fabrication and use of simple removable appliances and a fixed appliance technique for molar uprighting as an adjunctive orthodontic procedure.
4. Selected clinical topics: This includes a series of video cassettes on clinical procedures that often would be carried out outside the specialty practice of orthodontics.

Additional information about these audiovisual teaching materials can be obtained through direct contact with the Department of Orthodontics, UNC School of Dentistry, Chapel Hill, NC 27514.

The availability of color for the production of this book has been used in many line drawings in which color is used to enhance points requiring emphasis. A number of these drawings are modifications of illustrations by other authors, redrawn to take advantage of the availability of color. In all cases, these illustrations are used by permission and are acknowledged to the original source.

We would like to thank the staff of the UNC School of Dentistry Learning Resources Center, especially Warren McCollum, Tom Edwards, and Ramona Hutton-Howe, for art and photographic production; Nancy Arellano for secretarial and word processing support; Drs. Keith Black and Henry Zaytoun, Jr., for their assistance with organizing the illustrations for this volume; and our spouses and colleagues for their patience with this project.

Orthodontics has made tremendous strides in recent years, and it has been a pleasure to reflect on the extent of that progress during the preparation of this book. It also is gratifying to observe the increasing acceptance of orthodontic treatment in recent years and the continuing increase in the quality of treatment provided by well-trained and conscientious practitioners. We hope that this book contributes to continued progress in orthodontics.

William R. Proffit
Henry W. Fields, Jr.

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Chapter 1

Malocclusion and Dentofacial Deformity in Contemporary Society

■ *The Changing Goals of Orthodontic Treatment*

Crowded, irregular, and protruding teeth have been a problem for some individuals since antiquity, and attempts to correct this disorder go back at least to 1000 BC. Primitive (and surprisingly well designed) orthodontic appliances have been found in both Greek and Etruscan materials. As dentistry developed in the eighteenth and nineteenth centuries, a number of devices for the "regulation" of the teeth were described by various authors and apparently used sporadically by the dentists of that era.

After 1850, the first texts that systematically described orthodontics appeared, the most notable being Norman Kingsley's *Oral Deformities*.[1] Kingsley (Fig. 1-1), who had a tremendous influence on American dentistry in the latter half of the nineteenth century, was among the first to use extraoral force to correct protruding teeth. He was also a pioneer in treatment of cleft palate and related problems.

Despite the contributions of Kingsley and his contemporaries, their emphasis in orthodontics remained the alignment of the teeth and the correction of facial proportions. Little attention was paid to the dental occlusion, and since it was common practice to remove teeth for many dental problems, extractions for crowding or malalignment were frequent. In an era when an intact dentition was a rarity, the details of occlusal relationships were considered unimportant.

In order to make good prosthetic replacement teeth, it was necessary to develop a concept of occlusion, and this occurred in the late 1800s. As the concepts of prosthetic occlusion developed and were refined, it was natural to extend this to the natural dentition. Edward H. Angle (Fig. 1-2), whose influence began to be felt about 1890, can be credited with much of the development of a concept of occlusion in the natural dentition. Angle's original interest was in prosthodontics, and he taught in that department in the dental schools at Pennsylvania and Minnesota in the 1880s. His increasing interest in occlusion in the natural definition and in the treatment necessary to obtain normal occlusion, led directly to his development of orthodontics as a specialty, with himself as the "father of modern orthodontics."

The publication of Angle's classification of malocclusion in the 1890s[2] was an important step in the development of orthodontics not only because it subdivided major types of malocclusion but also included the first clear and simple definition of normal occlusion in the natural dentition. Angle's postulate was that the upper first molars were the key to occlusion and that the upper and lower molars should be related so that the mesiobuccal cusp of the upper molar occludes in the buccal groove of the lower molar. If this

Fig. 1-1 ■ Norman Kingsley's self-portrait. Kingsley, who was a noted sculptor and artist as well as an influential dentist, also served as Dean of the School of Dentistry at New York University.

molar relationship existed and the teeth were arranged on a smoothly curving line of occlusion (Fig. 1-3), then normal occlusion would result. This statement, which nearly 100 years of experience have proved to be correct except when there are aberrations in the size of teeth, brilliantly simplified normal occlusion.

Angle then described three classes of malocclusion, based on the occlusal relationships of the first molars:

- Class I — Normal relationship of the molars, but line of occlusion incorrect because of malposed teeth, rotations, or other causes
- Class II — Lower molar distally positioned relative to upper molar, line of occlusion not specified
- Class III — Lower molar mesially positioned relative to upper molar, line of occlusion not specified

Note that the Angle classification has four classes: normal occlusion, Class I malocclusion, Class II malocclusion, and Class III malocclusion (Fig. 1-4). Normal occlusion and Class I malocclusion share the same molar relationship, but differ in the arrangement of the teeth relative to the line of occlusion. The line of occlusion may or may not be correct in Class II and Class III.

With the establishment of a concept of normal occlusion and a classification scheme that incorporated the line of occlusion, by the early 1900s orthodontics was firmly established as the treatment of malocclusion, defined as any deviation from the ideal occlusal scheme described by Angle. Since precisely defined relationships required a full complement of teeth in both arches, maintaining an intact dentition became an important goal of orthodontic treatment. Angle and his followers strongly opposed extraction for orthodontic purposes. With the emphasis on dental occlusion that followed, however, less attention came to be paid to facial proportions and esthetics. Angle abandoned extraoral force because he found that it was not necessary to achieve proper occlusal relationships.

As time passed, it became clear that even an excellent occlusion was unsatisfactory if it was achieved at the expense of proper facial proportions. Not only were there esthetic problems, it often proved impossible to maintain an occlusal relationship achieved by prolonged use of heavy elastics to pull the teeth together as Angle and his followers had suggested. Extraction of teeth was reintroduced into orthodontics in the 1930s, to enhance facial esthetics and achieve better stability of the occlusal relationships.

Cephalometric radiography, which enabled orthodontists to measure the changes in tooth and jaw positions produced by growth and treatment, came into widespread use after World War II. These radiographs made it clear that many Class II and III malocclusions resulted from faulty jaw re-

Fig. 1-2 ■ Edward H. Angle in his early forties, near the time that he estatablished himself as the first dental specialist. From 1905 to 1928, Angle operated proprietary orthodontic schools in St. Louis, New London, Connecticut, and Pasadena, California, in which many of the pioneer American orthodontists were trained.

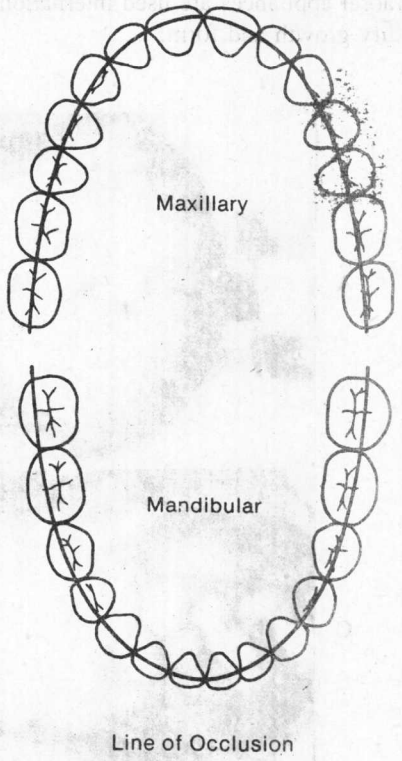

Fig. 1-3 ■ The line of occlusion is a smooth (catenary) curve passing through the central fossa of each upper molar and across the cingulum of the upper canine and incisor teeth. The same line runs along the buccal cusps and incisal edges of the lower teeth, thus specifying the occlusal as well as interarch relationships once the molar position is established.

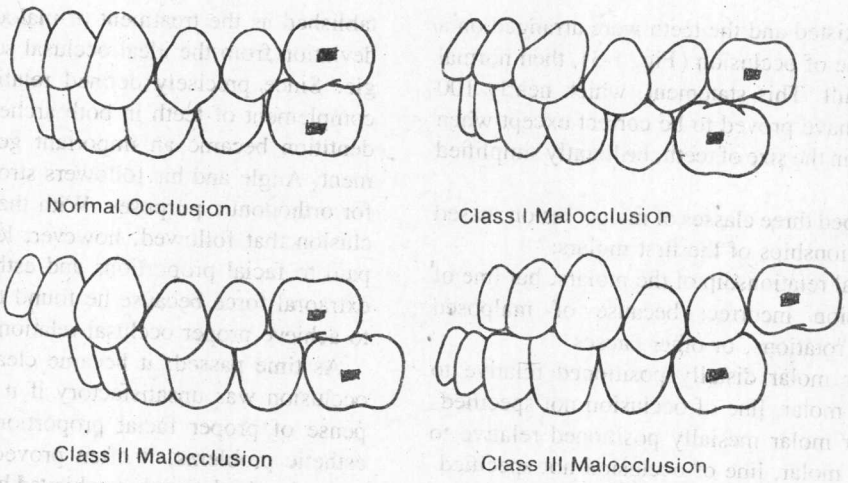

Fig. 1-4 ■ Normal occlusion and malocclusion classes as specified by Angle. This classification was quickly and widely adopted early in the twentieth century. It is incorporated within all contemporary descriptive and classification schemes.

lationships, not just malposed teeth. By use of cephalometrics, it also was possible to see that jaw growth could be altered by orthodontic treatment. In Europe, the method of "functional jaw orthopedics" was developed to enhance growth changes, while in the United States, extraoral force came to be used for this purpose. At present, both functional and extraoral appliances are used internationally to control and modify growth and form.

The goal of modern orthodontics can be summed up as the creation of the best possible occlusal relationships, within the framework of acceptable facial esthetics and stability of the occlusal result (Figs. 1-5 to 1-7). The most recent definition of orthodontics, as adopted by the American Association of Orthodontists in 1981, includes these three goals within the definition following:

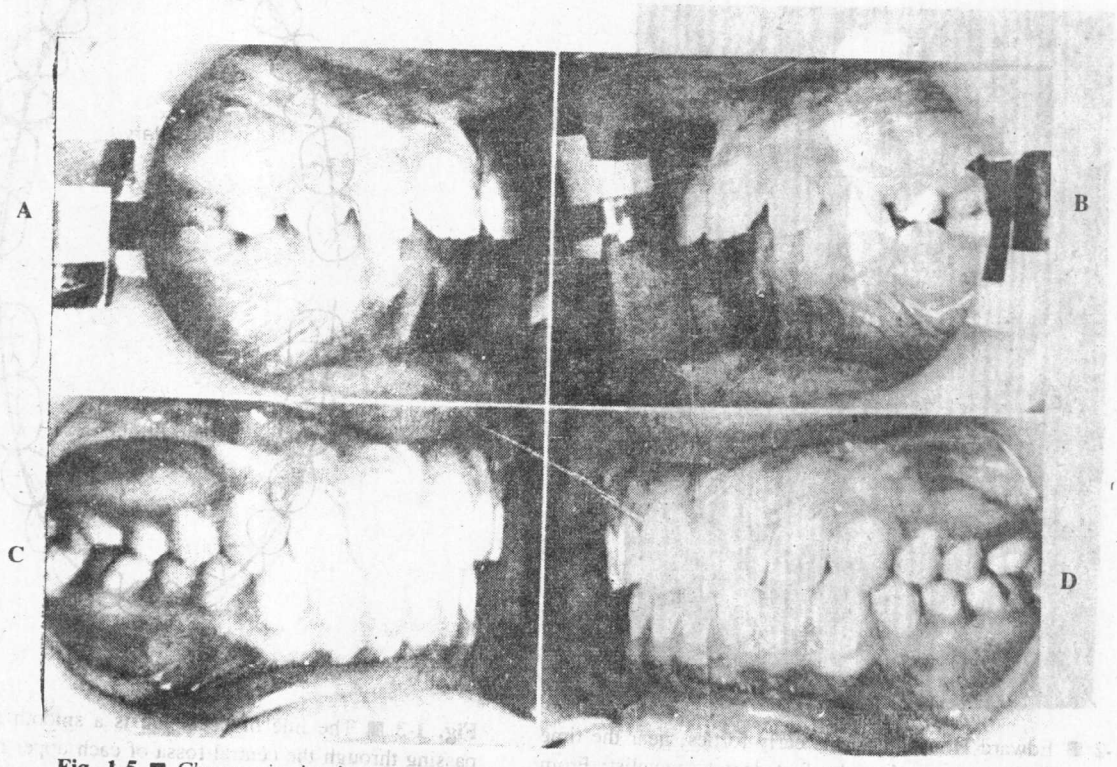

Fig. 1-5 ■ Changes in the dental occlusion produced by contemporary treatment. **A** and **B**, Pretreatment. **C** and **D**, Post-treatment. Two phases of treatment were used, first a functional appliance during the mixed dentition to influence jaw growth, then a fixed appliance to obtain excellent occlusal relationships.

Orthodontics (Dentofacial Orthopedics). The area of dentistry concerned with the supervision, guidance and correction of the growing and mature dentofacial structures, including those conditions that require movement of teeth or correction of malrelationships and malformations of related structures by the adjustment of relationships between and among teeth and facial bones by the application of forces and/or the stimulation and redirection of the functional forces within the craniofacial complex.

Major responsibilities of orthodontic practice include the diagnosis, prevention, interception and treatment of all forms of malocclusion of the teeth and associated alterations in their surrounding structures; the design, application and control of functional and corrective appliances; and the guidance of the dentition and its supporting structures to attain and maintain optimum relations in physiologic and esthetic harmony among facial and cranial structures.[3]

Fig. 1-6 ■ Changes in facial appearance produced by contemporary treatment (same patient as Fig. 1-5).

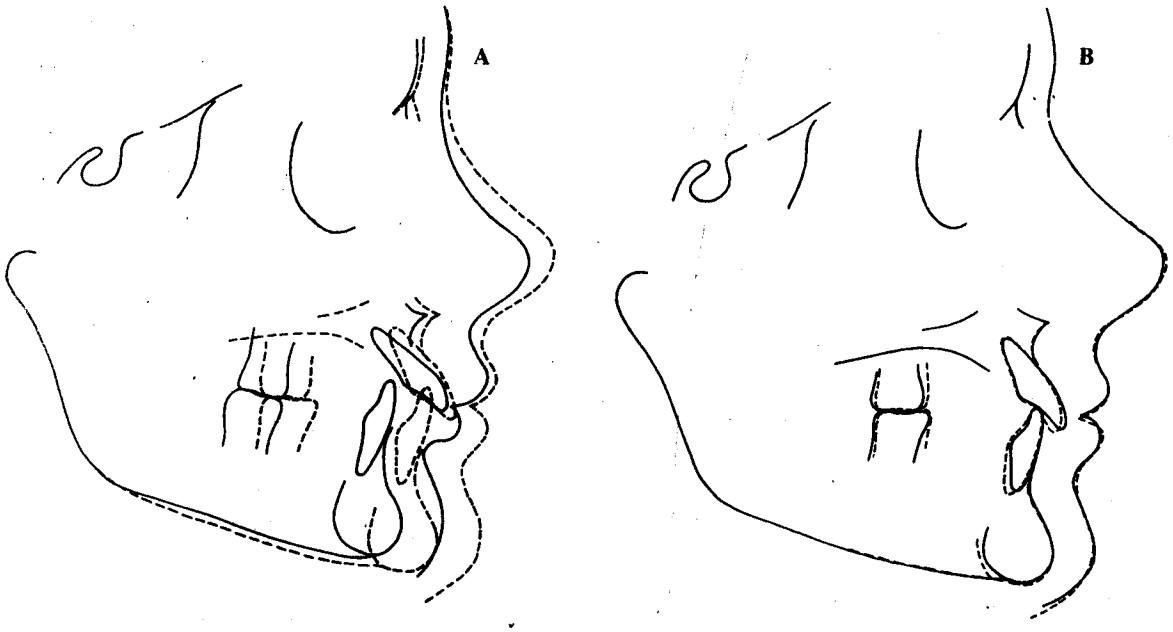

Fig. 1-7 ■ Superimposed cephalometric tracings, showing the skeletal and dental changes during treatment (same patient as Fig. 1-5). **A,** First phase of treatment (growth modification using functional appliance). **B,** Second phase of treatment (tooth positioning using complete fixed appliance).

■ *The Usual Orthodontic Problems: Epidemiology of Malocclusion*

What Angle defined as normal occlusion more properly should be considered the ideal normal, especially when the criteria are applied strictly. In fact, perfectly interdigitating teeth arranged along a perfectly regular line of occlusion are quite rare. For many years, epidemiologic studies of malocclusion suffered from considerable disagreement among the investigators about how much deviation from the ideal should be accepted within the bounds of normal. As a result, between 1930 and 1965 the prevalence of malocclusion in the United States was variously estimated as 35% to 95%.[4] These tremendous disparities were largely the result of the investigators' differing criteria for normal, not to population differences. Variations were also seen because the Angle classification is not a description of occlusal relationships sufficient for epidemiologic purposes.

Since 1960, a series of studies carried out by the U.S. Public Health Service (USPHS), the National Health Service in Britain, the World Health Organization, and other public health or university groups in most developed countries have provided a reasonably clear worldwide picture of the prevalence of various occlusal relationships or malrelationships. These studies of need and demand for orthodontic treatment have recently been reviewed.[5]

In the United States, two large scale surveys carried out by the Division of Health Statistics of the U.S. Public Health Service covered children ages 6 to 11 between 1963 and 1965, and youths ages 12 to 17 between 1969 and 1970. These surveys, published in the 1970s,[6,7] are by far the most thorough epidemiologic studies of occlusal relationships ever undertaken. Each was based on a sample of approximately 8,000 children or youths, selected to statistically represent the approximately 26 million individuals in the U.S. in those age ranges (excluding children living on Indian reservations).

To avoid judgment on how much was too much for a given characteristic, the data were tabulated by millimeters of deviation from ideal, allowing the user of the data to reach his own conclusions about admittedly controversial points. Data from these surveys are briefly discussed here and summarized in Tables 1 and 2.

The first point that the USPHS epidemiologic data makes clear is that the majority of American children and youths have a malocclusion of some type. In these studies, in addition to measurements of specific characteristics, Grainger's Treatment Priority Index (TPI)[8] was used to score the occlusion, providing an indicator of the overall severity of any occlusal problems. Approximately 25% had scores on the Treatment Priority Index of zero, indicating a near-ideal occlusion; the other 75% had some noticeable deviation from ideal occlusion. The percentage of youths age 12 to 17 with mild and moderate malocclusion was similar, but fewer in this age group had a zero score and considerably more had severe or very severe malocclusion (Table 1-1).

Since the Treatment Priority Index scores only occlusal characteristics, excluding skeletal and facial components, TPI scores do not necessarily coincide with the judgment clinicians would make, but they do indicate the relative proportions of children with increasingly severe malocclusion problems.

Table 1-1 ■ TPI Scores, U.S. children and youths

	Percent distribution			
	Age 6-11		*Age 12-17*	
TPI score	*White*	*Black*	*White*	*Black*
0 (near-ideal occlusion)	22.9	33.1	10.5	14.7
1-3 (mild malocclusion)	39.7	35.0	34.6	36.9
4-6 (moderate malocclusion)	23.7	15.0	25.7	21.0
>6 (severe or very severe)	13.7	16.9	29.2	27.4

Table 1-2 ■ Percent of U.S. children and youths with malocclusion types

	Age 6-11		*Age 12-17*	
	White	*Black*	*White*	*Black*
Crowding/malalignment problems				
Tooth displacement score 0 (ideal)	56.8	64.6	13.0	16.0
Tooth displacement score 1-5 (moderate)	38.9	32.6	43.6	49.5
Tooth displacement score >5 (severe)	4.3	2.6	43.4	34.5
Anteroposterior problems				
Overjet, 6 mm or more	17.3	13.5	15.3	11.8
Lower overjet, 1 mm or more	0.8	0.6	0.8	1.2
Vertical problems				
Open bite, 2 mm or more	1.4	9.6	1.2	10.1
Overbite, 6 mm or more	7.6	0.8	11.7	1.4
Transverse problems				
Lingual crossbite, 2 or more teeth	4.9	5.3	5.9	8.0
Buccal crossbite, 2 or more teeth	1.0	0.4	1.6	1.0

As might be expected, crowded malaligned teeth are the most common single contributor to malocclusion. About 40% of children and 85% of youths had some degree of malalignment within the dental arches, that is, a tooth displacement score other than zero (Table 1-2).

Excessive protrusion of maxillary incisors (overjet) was the second most common finding (Fig. 1-8). An overjet of 6 mm or more was found approximately 17% of children and 15% of youths. It is probable that many of these patients have a discrepancy in the size or position of the jaws, not just displacement of the teeth, but the survey provides no direct evidence on this point.

The other extreme in anteroposterior relationships, lower overjet with a Class III molar relationship, is uncommon in the U.S. population, occurring in less than 1% of all children and white youths, and just over 1% of black youths.

Vertical problems of anterior open bite versus excessive overbite (Fig. 1-9) are especially interesting because of the large racial differences in this characteristic. Just over 1% of white children, but nearly 10% of black, have 2 mm or more of anterior open bite. At the other end of the spectrum, 11.7% of white adolescents, but only 1.4% of blacks, have an overbite of 6 mm or more. This finding undoubtedly is related to different vertical facial proportions in the two groups, rather than to a different prevalence of habits or other causes (see Chapter 3 for a more detailed discussion.)

It is interesting to note that the number of children reported by their parents to suck their thumb every day or night is higher at all ages than the number of children with anterior open bite, indicating that even frequent thumb-sucking does not necessarily cause an open bite although a positive and significant correlation exists.

Problems in transverse dental relationships (posterior crossbites) (Fig. 1-10) are uncommon, occurring in about

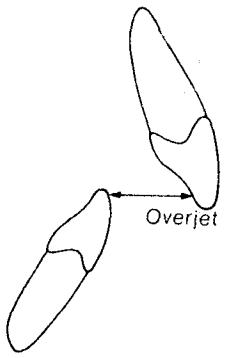

Fig. 1-8 ■ Overjet is defined as horizontal overlap of the incisors. Normally, the incisors are in contact, with the upper incisors ahead of the lower by only the thickness of the upper edges, i.e., 2 to 3 mm overjet is the normal relationship. If the lower incisors are in front of the upper incisors, the condition is called lower overjet, reverse overjet, or anterior crossbite.

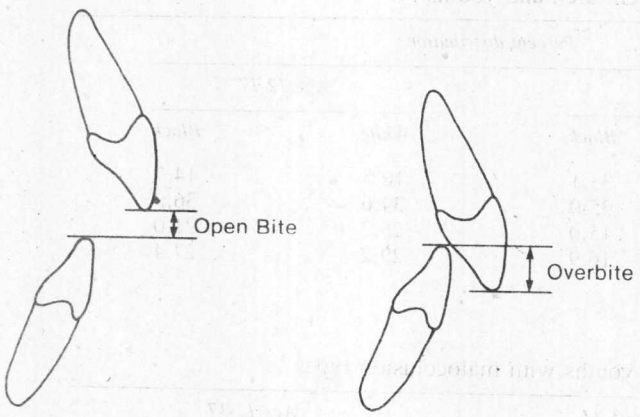

Fig. 1-9 ■ Overbite is defined as vertical overlap of the incisors. Normally, the lower incisal edges contact the lingual surface of the upper incisors at or above the cingulum, i.e., normally there is 1 to 2 mm overbite. In open bite, there is no vertical overlap, and the vertical separation is measured.

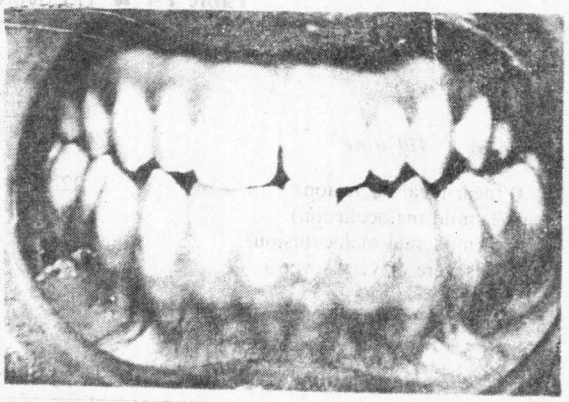

Fig. 1-10 ■ Posterior crossbite occurs when the line of occlusion is incorrect buccolingually. Usually, as in this child, the upper teeth are positioned lingually to the lower teeth. This is called lingual crossbite or just posterior crossbite. In buccal crossbite, which occurs rarely, if the upper teeth are too far buccally, there is no occlusal contact at all.

5% of children and 6% to 8% of youths, with minimal racial differences. When a transverse problem does exist, it is much more likely to be a relative narrowing of the maxillary arch (lingual crossbite) than buccal crossbite resulting from a relatively wide maxilla.

Although the Angle classification was not used in the USPHS survey—appropriately, since this classification scheme does not offer the necessary differentiation of vertical and transverse problems—it is interesting to calculate the percentage of individuals who would fall into Angle's four groups. From this approach, 25% at most have normal occlusion. Class I malocclusion (50% to 55%) is by far the largest single group; there are nearly but not quite as many Class II malocclusions (15% to 20%) as normal occlusion; Class III (1%) represents a very small proportion of the total.

■ *Need and Demand for Orthodontic Treatment*

■ Need for Treatment

Protruding, irregular, or malocclusion teeth can cause three types of problems for the patient: (1) psychosocial problems related to impaired dentofacial esthetics; (2) problems with oral function, including difficulties in jaw movement (muscle incoordination or pain), temporomandibular joint disturbances, and problems with mastication, swallowing, or speech; and (3) problems of accentuated periodontal disease or tooth decay related to malocclusion.

Psychosocial problems. A number of studies in recent years have confirmed what is intuitively obvious, that severe malocclusion can be a social handicap.[9,10] The usual caricature of an individual who is none too bright includes extremely protruding teeth. Several psychologic studies in recent years have confirmed that well aligned teeth and a pleasing smile carry positive status at all social levels, whereas irregular or protruding teeth carry negative status. Appearance can and does make a difference in teachers' expectations and therefore progress in school, in employability, and in competition for a mate and marriageability. Tests of the psychologic reactions of individuals to various dental conditions, carried out by showing photographs of various mouths to the individual whose response was being evaluated, show that cultural differences are smaller than might have been anticipated. A dental appearance pleasing to Americans is also judged pleasing in Australia and East Germany, whereas a dental appearance considered in the U.S. to carry with it some social handicap draws about the same response in these other cultural settings[11] (Fig. 1-11). There is no doubt that social responses conditioned by the appearance of the teeth can severely affect an individual's whole adaptation to life. This places the concept "handicapping malocclusion" in a larger and more important context. If the way you interact with other individuals is affected constantly by your teeth, your dental handicap is far from trivial.

It is interesting that psychic distress caused by disfiguring dental or facial conditions is not directly proportional to the anatomic severity of the problem. An individual who is grossly disfigured can anticipate a consistently negative response. An individual with an apparently less severe problem (for example, a protruding chin or irregular incisors) is sometimes treated differently because of this, but sometimes not. It seems to be easier to cope with a defect if other people's responses to it are consistent than if they are not. Unpredictable responses produce anxiety and can have strong deleterious effects.[12]

The impact of a physical defect on an individual also will be strongly influenced by that individual's self-esteem and

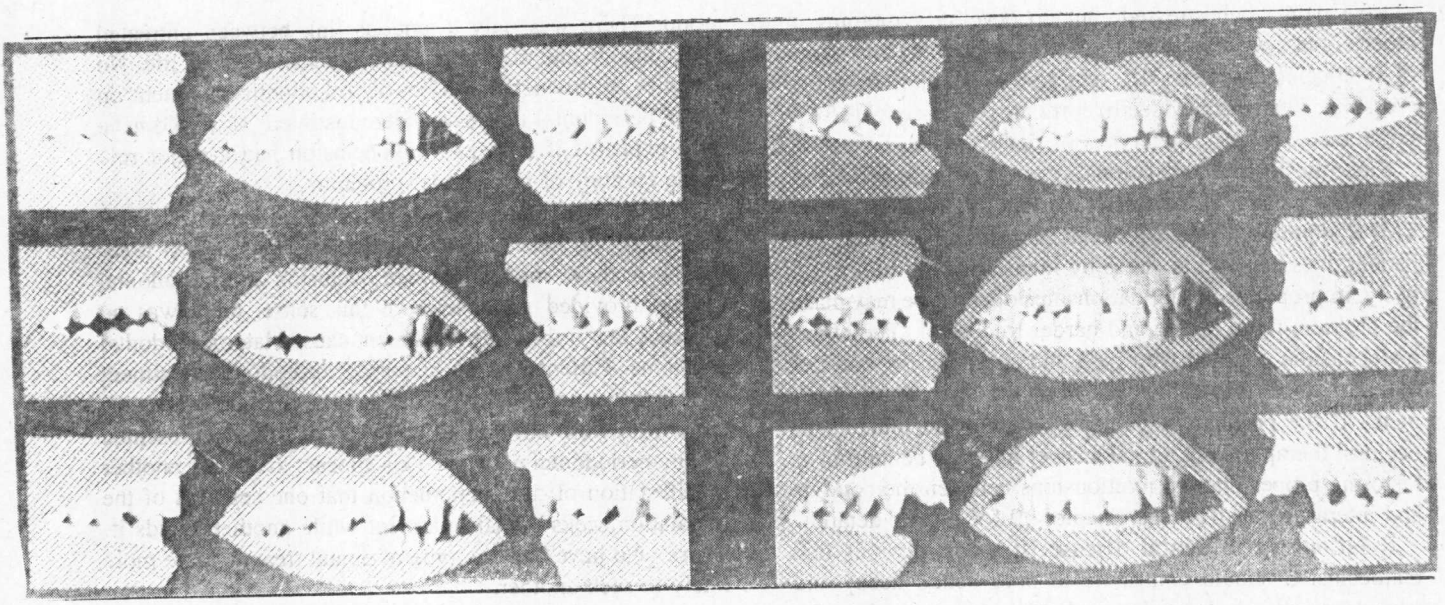

Fig. 1-11 ■ Examples of stimulus photographs used by Cons et al.[11] to study reactions to various dental conditions. A dental appearance like those in the bottom row carries negative social status; those in the top row are positive, and the middle row intermediate. Studies of this type have confirmed the impression that dental appearance affects social interactions.

Table 1-3 ■ Speech difficulties related to malocclusion

Speech sound	*Problem*	*Related malocclusion*
/s/, /z/ (sibilants)	Lisp	Anterior open bite, large gap between incisors
/t/, /d/ (linguoalveolar stops)	Diffulty in production	Irregular incisors, especially lingual position of maxillary incisors
/f/, /v/ (labiodental fricatives)	Distortion	Skeletal Class III
th, sh, ch (linguodental fricatives) (voiced or voiceless)	Distortion	Anterior open bite

the extent of his or her positive feelings about themselves. The result is that a degree of anatomic abnormality that is merely a condition of no great consequence to one individual can be a genuinely severe problem to another.

Oral function. A severe malocclusion may compromise all aspects of oral function. There may be difficulty in mastication if only a few teeth meet, and jaw discrepancies may force adaptive alterations in swallowing. It can be difficult or impossible to produce certain sounds in the presence of severe malocclusion (Table 1-3), and effective speech therapy may require some preliminary orthodontic treatment. Even less severe malocclusions tend to affect mastication, swallowing, and speech, not so much by making the function impossible as by requiring physiologic compensation for the anatomic deformity.

The relationship of malocclusion and adaptive function to the temporomandibular joint (TMJ) syndrome, manifested as pain in and around the temporomandibular joint, remains unclear and controversial. TMJ pain may result from pathologic changes within the temporomandibular joint, but more often is caused by muscle fatigue and spasm. Muscle pain almost always correlates with a history of posturing the mandible to an anterior or lateral position, or clenching or grinding the teeth as a response to stressful situations. The excessive muscle activity accompanying clenching or grinding may occur during the day or may be present during sleep.

Some dentists have suggested that even minor imperfections in the occlusion serve to trigger clenching and grinding activities. If this were true, it would indicate a real need for perfecting the occlusion in everyone, to avoid the possibility of developing facial muscle pain. Because the number of people with moderate degrees of malocclusion (50% to 75% of the population) far exceeds the number with TMJ problems (5% to 30%, depending on which symptoms are examined),[13,14] it seems unlikely that occlusal patterns alone are enough to cause hyperactivity of the oral musculature. Some individuals with poor occlusion have no problem with

muscle pain when stressed, but do develop symptoms in other organ systems. Swedish data indicate that some types of malocclusion (Class III, anterior open bite, posterior crossbite, rotated/tipped teeth) correlate positively with TMJ problems, whereas other types of malocclusion do not.[15]

Since the postive correlations are not very large, it appears that malocclusion alone cannot explain the development of TMJ symptoms in most patients. On the other hand, if a patient does respond to stress by increased oral muscle activity, improper occlusal relationships of any type may make the problem more severe and harder to control. Therefore, malocclusion coupled with pain and spasm in the muscles of mastication may indicate a need for orthodontic treatment. If the problem is pathology within the joint itself, occlusal therapy is not a total answer but may be helpful in restoring proper internal relationships between the condyle and interarticular disk (see Chapter 19 for further details).

Relationship to dental disease. It seems obvious that malocclusion should contribute to both dental decay and periodontal disease by making it harder to care for the teeth properly. An individual's willingness and motivation determine his oral hygiene much more than how well the teeth are aligned, and presence or absence of dental plaque is the major determinant of the health of both the hard and soft tissues of the mouth. Studies of factors that influence tooth decay suggest that if individuals with malocclusion are more prone to tooth decay, the effect is small compared to hygiene status.[16]

It was once thought that trauma from occlusion played a significant role in the pathogenesis of periodontal disease. Studies in recent years reveal that how well the patient controls plaque is by far the strongest determinant of periodontal disease status, and the patient's occlusion in comparison plays a secondary role.[17] Occlusal trauma now receives much less emphasis as a primary etiologic factor for periodontal disease.

Two studies carried out in the late 1970s, in which a large number of patients were carefully examined 10 to 20 years after completion of orthodontic treatment, shed some light on the malocclusion–oral health relationship.[18,19] In both studies, comparison of the patients who underwent orthodontic treatment years ago with untreated individuals in the same age group showed similar periodontal status, despite the better functional occlusions of the orthodontically treated group. There was only a tenuous link between untreated malocclusion and major periodontal disease later in life. No evidence of a beneficial effect of orthodontic treatment on future periodontal health was demonstrated, as would have been expected if untreated malocclusion had a major role in the etiology of periodontal problems.

It has been suggested that previous orthodontic treatment predisposes to later periodontal disease. The lack of association in these studies between occlusion and periodontal disease provided good news in this sense: there was no evidence that orthodontic treatment caused later periodontal problems. Patients with a history of orthodontic treatment appear to be more likely to seek later periodontal care than those who were not treated, and thus are over-represented among periodontal patients. This appears to be only another manifestation of the phenomenon that one segment of the population seeks dental treatment while another avoids it. Those who have had one type of dental treatment are more likely to seek another.

In summary, it appears that problems related to both esthetics and oral function can produce significant need for orthodontic treatment. The evidence is less clear that orthodontic treatment reduces the development of later dental disease.

Demand for Orthodontic Treatment

Demand for orthodontic treatment is indicated by the number of patients who actually make appointments and seek care. Need for treatment is more difficult to measure. This refers to the number of individuals who have an orthodontic problem and who would benefit from treatment. Not all patients with malocclusion, even those with extreme anatomic deviations from the normal, seek orthodontic treatment. Some do not recognize that they have a problem; others feel that they need treatment but cannot afford it or cannot obtain it. Data from the USPHS epidemiologic surveys[6,7] suggest that in typical American neighborhoods, about 35% of adolescents are perceived by parents and peers as needing orthodontic treatment. Dentists recommend treatment for another 20% (Table 1-4).

As might be expected, both the perceived need and demand vary with social and cultural conditions. More children in urban areas are thought (by parents and peers) to need treatment than children in rural areas, although the

Table 1-4 Perceived need and demand for orthodontic treatment, United States, 1966-1970 (percent distribution)

	Age 6-11		*Age 12-17*			
			Boys		*Girls*	
	Boys	*Girls*	*White*	*Black*	*White*	*Black*
Parent/dentist perceived need	10.6	11.6	55.8		53.5	
Child/youth perceived need	—	—	17.6	20.3	18.3	21.5
Received treatment	2.4	2.6	9.6		11.8	
Perceived to need treatment, but not treated	—	—	10.9	9.3	13.3	9.7

prevalence of occlusal disharmony is similar. Dental and facial appearance is a major factor in the perception of need for treatment. Demand for orthodontic treatment is correlated with family income: all other factors being equal, the higher the income, the greater the demand for orthodontic treatment. This appears to reflect not only that higher income families can more easily afford orthodontic treatment but also that good facial appearance and avoidance of disfiguring dental conditions are associated with more prestigious social positions and occupations. The higher the aspirations for a child, the more likely the parent is to seek orthodontic treatment for him or her.

The effect of financial constraints on demand can be seen most clearly by the response to third-party payment plans. When third-party copayment is available, the number of individuals seeking orthodontic treatment rises considerably. Although reliable current data are not available, the number of children and youths who receive treatment has increased since the USPHS survey, perhaps to 15% to 20%. It is likely that demand for treatment will more closely approach the 35% level thought by the public to need treatment as orthodontic coinsurance becomes more widely available.

The number of adults seeking orthodontic treatment has increased rapidly since 1970. In the 1960s, 5% or less of all orthodontic patients were adults. By the mid-1980s, surveys of practitioners indicated that the figure was approaching 20%.[20] Many of these patients indicate that they wanted treatment earlier but did not receive it, often because their family could not afford it; now they can. Wearing braces as an adult is more socially acceptable than it was previously, though no one really knows why, and this too has made it easier for adults to seek treatment.

Orthodontics has become a more prominent part of den-

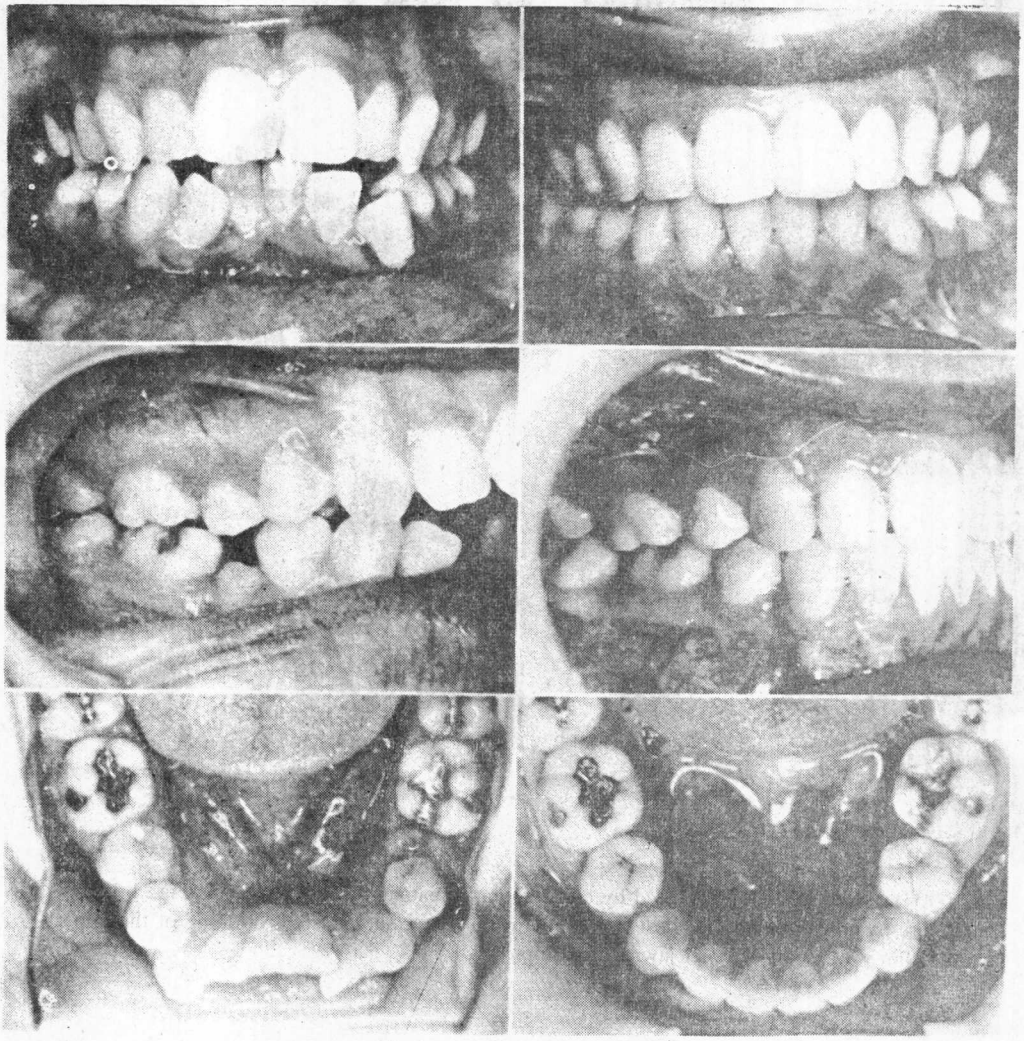

Fig. 1-12 ■ Occlusal changes produced in a nongrowing patient by contemporary orthodontic treatment (*Left column:* pre-treatment; *right column:* post-treatment). Note that first premolar teeth have been extracted to allow better lip contours and provide a more stable result.