Preventive and Interceptive Orthodontics: A Strong Theory Proves Weak In Practice

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Man's normal period of postnatal craniofacial growth and development is unusually protracted compared to nonhuman primates. In lower animals an arrest or delay of development at an embryonic stage is called neoteny, and man's slow postnatal development in many ways is reminiscent of this. The teleologic explanation is that for man to acquire knowledge and skills such as language development and abstract thinking, considerable time for the growth and programming of the human brain is necessary. This theory further deduces that the long period of physical dependence of the child on parents allows for this programming to occur. Be that as it may, the facts that the human neonate remains edentulous for a relatively long period of time and that the development of man's dentition spans twelve years are excellent examples of human neoteny. From a phylogenetic viewpoint, with neoteny came a greater possibility for morphological variation, and nowhere is this more evident than in the dental occlusion of modern man.

Early in recorded history there were references to dental variations and to the role that orderly transition of the primary to the permanent dentition plays in normal development. Celsus observed in 25 B.C. that overretention of primary teeth could cause displacement of developing permanent teeth and that finger pressure seemed to help guide the permanent tooth into place after the primary tooth was removed.[1]

The complex interplay between inherited and environmental influences makes it difficult to evaluate the relative importance of each in the etiology of malocclusion. The long developmental period makes it possible for many external influences to affect the dentition. It is accepted as a premise that a normal primary dentition and a normal transition from the primary to the permanent dentition are necessary to establish a normal adult occlusion. It has been one of the major goals of modern orthodontics to understand this transition process well enough to prevent or intercept developing malocclusion caused by aberrations in the developmental process. Presumably, if man were not diphyodont (if there were not two dentitions) there would be no need for preventive or interceptive orthodontics. Unfortunately, the terms "preventive orthodontics" and "interceptive orthodontics" have been used so widely to describe a variety of procedures in orthodontics that both have almost lost any practical meaning. A major reason for this has been confusion between the conceptual and operational definitions of both terms. Conceptually, these terms relate to the possibility of treating young patients in ways which will obviate the need for later comprehensive orthodontic treatment. Usually, but not always, this means altering external influences on the developmental process. Operationally, they concern specific procedures or techniques in treatment of patients.

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In this paper we will present first our current understanding of influences on the dentition which can lead to the development of malocclusions. In doing so, we will outline the theoretical opportunities for preventive and interceptive orthodontics. Second, we will attempt to clarify the conceptual and operational definitions of these terms. Finally, we will present the results of a five-year clinical study at the University of Pennsylvania in which such treatment was offered. The study was designed to test the extent to which preventive and interceptive orthodontics is a practical clinical approach. Its major goal was to determine the percentage of patients who are likely to receive long-term benefit from single-phase early orthodontic treatment of the type traditionally thought of as preventive and interceptive. The implications of the findings as they relate to public policy and dental education will be explored.

Dentitional Growth, Development and Maturation

Each of the processes involved in the transition of the dentition relates closely to growth, development, and maturation of the stomatognathic system. The increases in size and changes in proportion of the dental arches are obvious even to the casual observer. Major dimensional changes in arch length accompany the addition of the accessional teeth. There also are major changes in the vertical relationships of the facial skeleton (and sometimes in the lateral and anteroposterior relationships as well). Up to two centimeters of vertical growth of the face occurs after the permanent teeth emerge. These spatial changes provide enormous potential for misdirected positioning of the teeth and production of malocclusion. The nine years from the completion of the primary dentition at age three to the full adult dentition (less the third molars) at age twelve, provide ample time for alterations in dentofacial development to become apparent. Developmental changes in dental arch dimensions have been well-documented by Friel,[2] Sillman,[3] Baume[4] and Moorrees[5] among others, while changes in facial proportions and particularly changes in face height accompanying dental development have been emphasized by Broadbent,[6] Brodie[7] and Björk.[8]

More subtle relationships in craniofacial growth and development involve the timetable or biological clock on which each of these processes proceeds.[9] There are three major maturational indices in addition to chronological age which have a strong bearing on dentitional development. These indices are dental age, skeletal age, and oral-pharyngeal maturational age. Chronological age is based on sidereal time. Dental age relates to gingival emergence of teeth and the degree of root development. Skeletal age is linked to the ossification centers of the skeleton. Traditionally, carpal cartilage ossification has been used as the measure of skeletal maturation. Oral-pharyngeal maturational age relates to the neuromuscular functions of the oral portal such as respiration, mastication, swallowing and speech. The posture and resting pressures of the various anatomical structures involved are probably the most important considerations related to the other features of somatic growth and development of the jaws and teeth. At the present time there is not an index *per se* for assessing oral pharyngeal maturational age; however, it is now well-accepted that both mastication and swallowing, as well as speech, proceed from a normal immature pattern in the child to a normal mature pattern in the young adult.[10] The timing of this transition may influence growth and development of the face and dentition.

Major Factors in the Development of the Dentition

The three major factors involved in the development of the dentition are eruption, drift and equilibrium. Eruption should be defined as those changes in tooth positioning which take place prior to gingival emergence of the tooth. In the past this has been referred to as the pre-emergence phase of eruption. Although the mechanism of tooth eruption remains poorly understood, it is apparent that the position of the developing tooth, as well as the timing and sequence of eruption of the teeth, is largely under genetic control. However, as Fanning[11] has documented, premature or late shedding of the primary teeth can affect the sequence, timing, and position of eruption of the successional teeth leading to adverse changes in occlusion.

Once gingival emergence of the crown of the tooth occurs, the term "drift," as suggested by Enlow,[12] is most appropriate for describing further change in the position of the tooth. At this time the emerging tooth encounters strong environmental influences. It can be thought of as emerging from the skeletal to the visceral zone or, as Brodie[13] called it, the intestinal zone. Since, after it emerges, the tooth moves in all three planes of space, it is confusing to call continued vertical movement the postemergence phase of eruption, while calling any mesiodistal or transverse movements drift. Therefore, we refer to postemergence vertical movement as vertical drift. This also intentionally implies that the vertical movement is allowed to occur, by growth or jaw positioning, in the same way that drift is allowed or not in the other planes of space.

The factor of equilibrium refers to the form-function relationships in dentofacial development which are influenced by the pattern of skeletal growth and by local factors. Tooth position at any given time is the result of the interaction of forces stemming from the soft tissues around the oral cavity (including but not limited to the musculature), the periodontal apparatus, and the occlusion. Almost uniquely in this system, form can adapt to function as well as function adapting to form. There is a delicate feedback between events. For example, a rapid change in form such as that produced by the early extraction of a primary tooth can affect resting tongue position, which in turn can gradually alter the vertical drift of teeth in that area. Short-term form-function interactions in the oral area consist almost totally of function adapting to changes in form. In the long term, form can and does adapt to function, primarily as the drift of teeth is affected in all three planes of space by alterations in tongue, jaw, and head posture. In a classic paper Weinstein[14] considered the balance of forces which maintain this changing system in a dynamic equilibrium; recently equilibrium theory has been reviewed and updated by Proffit.[15]

Mechanisms and Determinants of Occlusion

An attractive hypothesis is that synchronous timing of dental, skeletal and oral pharyngeal functional development is essential for normal occlusion to occur as an outcome of the interrelated processes of eruption, drift and equilibrium.[16] The process of eruption is related directly to the maturational scale of dental age. The process of drift, particularly vertical drift as it accompanies jaw growth, is directly linked to the maturational timetable of skeletal age. The process of equilibrium is closely tied to oral-pharyngeal maturational age. If these processes are not synchronized, the development of the occlusion will be affected and malocclusion can result. For example, an advanced dental age and skeletal age accompanied by a lagging oral-pharyngeal maturational age with accompanying characteristic tongue posture may lead to problems in the vertical and transverse development of the face and dentition, which secondarily can cause problems in anteroposterior relationships because of adverse rotational changes during jaw growth. The degree of occlusal disharmony that will result is determined by the extent of compensatory changes in growth. Since growth also has strong genetic controls, it is difficult to know how much of any particular malocclusion was caused by developmental factors and how much was genetically programmed.

In a general sense it is possible to say that genetic, epigenetic and environmental etiological control factors are responsible for maintaining the delicate balance of this complex system.[17] Genetic determinants are the information derived from the codes contained in the cell nucleus. Epigenetic control factors are indirectly under genetic influence and are expressed through some mechanism other than direct gene action. Neurotropism would be an example of epigenetic control where the signal, although originally derived genetic information, is transmitted by way of sensory nerves and biochemical moieties secreted at synaptic junctions. Whereas genetic and epigenetic factors are intrinsic, environmental factors are extrinsic. These extrinsic factors can be general or local. Thus, factors such as nutritional deficiencies or hormonal imbalances are general, while sucking habits or early loss of primary teeth are examples of local environmental influences on the developing dentition.

Moss' model of the oral environment as a functional matrix is useful in attempting to understand the complex interrelationships of the factors responsible for the growth, development and maturation of the face and dentition.[18] The Moss hypothesis is simply that the bones of the craniofacial complex develop within envelopes which influence their growth at several levels. The periosteal matrices are the soft-tissue envelopes which exert the genetic and epigenetic control over the osseous tissues. The capsular matrices are the functioning muscles and oral spaces which exert epigenetic and environmental control over the developing bony units. Thus, intrinsic factors are largely responsible for the size and shape of the separate bony units of the face, whereas both intrinsic and extrinisc factors are responsible for relationships of these bony units and the overall facial pattern.[19] During tooth eruption (before gingival emergence) the developing teeth are under the influence of the skeletal system, and control is almost totally genetic or epigenetic. Once the teeth emerge and begin to drift, the tooth crowns come under the influence of the visceral system and are subject to extrinsic influences whereas the roots to a large extent remain related to the skeletal system.

While the teeth are emerging and drifting, the maxilla and mandible are undergoing primary and secondary displacement with resultant downward and forward growth.

	Early loss of primary tooth	Delayed loss of primary tooth	Supernumerary tooth	Congenital absence of tooth	Ectopic position of tooth bud	Trauma to tooth	Ankylosis	Pathology (cyst, tumor, etc.)	Idiopathic failure of eruption mechanism	Habits	Occlusal interference	Respiratory difficulties	Skeletal growth dysplasias
ERUPTION - timing, sequence	++	++	+		+	+	+	+	+				
- position	±	++	+	±	+++	+	±	++					
DRIFT - vertical	+						+		++	+		++	+
- mesio-distal	+++		±	+			±			+	++	+	+
- bucco-lingual	±		±							+	++	+	+
EQUILIBRIUM - tongue/lip	±									+		+	+
- periodontium									++				
- occlusion	+	+	±	±			+		+	+	+	+	+

+ = effect

± = sometimes

TABLE I

Along with the resultant downward and forward vector of facial growth is a rotational growth component which can lead to a forward or backward direction of the tip of the palatal plane, the occlusal plane and the mandibular plane (corpus axis). The relative amount of vertical drift of the anterior and posterior teeth (differential eruption) can both influence and be influenced by this rotational growth component. It is at this level that form-function adaptive changes seem to have the greatest influence on the growing face.

It should be evident that in a theoretical sense an interference with the development of the dentition can occur at any level, be it with intrinsic or extrinsic factors. From a clinical point of view local extrinsic factors are the most relevant to preventive and interceptive orthodontics, but their interaction with intrinsic influences must be kept in mind.

In Table I the effect of various interferences with eruption, drift and equilibrium as the major processes in dentitional development is displayed. From this table the theoretical opportunities for preventive and interceptive orthodontics may be derived. For example, consider the impact of early loss of a primary tooth and thereby the conditions for the preventive and interceptive treatment procedure of space maintenance:

Eruption. Since early loss can either accelerate or delay eruption of the succedaneous tooth, this can affect eruption, sequence and timing. It will alter position of the permanent tooth but only in a special circumstance: following very early loss of a second primary molar, the permanent first molar may erupt mesially. Otherwise, space loss associated with drift is primarily a posteruption phenomenon.

Drift. Early loss leads to vertical drift of the opposing primary tooth and to mesiodistal drift of the permanent molars and incisors; it rarely leads to buccolingual drift of permanent or primary teeth. Mesial drift of the permanent molars is a well-recognized phenomenon. It is not well-recognized that (a) mesial or distal drift of *primary* teeth rarely occurs. If a first primary molar is lost prematurely, space loss is unlikely (though possible). When space loss does occur in this circumstance, distal movement of the anterior segment is as likely as mesial movement of the posterior segment. An intact primary second molar or canine, in other words, is in itself a good space maintainer; (b) *distal* drift of permanent incisors is as much to be expected as mesial drift of molars. Early loss of primary canines almost invariably leads to space loss by distal movement of the permanent incisors, not by mesial movement of the primary and permanent molars.

Equilibrium. Only minor equilibrium effects are associated with early loss. Forces generated in the periodontal ligament are not affected, but resting tongue and lip pressure may be. The tongue will tend to partially occupy a space in the dental arch and lip posture may be affected by early loss of primary incisors. An altered chewing pattern, to avoid the side where a tooth is missing, may result. There is little or no evidence, however, that these possible changes will influence tooth position significantly.

From this analysis it can be seen that space maintenance, as a preventive and interceptive procedure, is needed to deal with the consequences of potential mesial drift of permanent molars *or* distal drift of incisors, plus the altered sequence and timing of eruption. Although a device to maintain space can prevent mesiodistal drift, it cannot prevent the eruption changes nor, in most instances, vertical drift and equilibrium effects. Controlling vertical drift and equilibrium would require a replacement for the missing tooth. The clinical judgment that this is unnecessary reflects the conclusion that both vertical drift and equilibrium effects are minor.

As another example, consider the impact of ectopic position of a tooth bud. This may alter both sequence and timing but the major effect is on the position of eruption. Once the tooth erupts, neither drift nor equilibrium are likely to be affected *unless* another interference with development also comes into play. For instance, ectopic position of a maxillary first permanent molar is fairly common. If this can be corrected without loss of the second primary molar in that quadrant, all will be well after the tooth erupts because further interferences with development will be minimal at worst. But if the ectopic position leads to early loss of the primary molar, all the consequences of that interference will follow.

In the final examples, consider the effect on dentofacial development of respiratory difficulties. Experimental work with primates has shown that interference with nasal respiration leads to compensatory changes in facial morphology and dental relationships. At present, considerable emphasis is being placed on apparently analogous problems in human patients. Eruption of the teeth is not modified, but effects on drift of the teeth occur in all three planes of space, especially the vertical. Tongue-lip equilibrium is concerned as resting posture adapts to respiratory needs. Occlusal forces change as jaw posture is altered. Compare this picture to the effects of a skeletal growth dysplasia. Due to an alteration in the growth process itself (presumably, this is an innate problem rather than an interference with what otherwise would be normal development). The impact on the developing dentition is very similar. In fact, if only vertical growth were affected, it could be almost exactly the same.

For any individual patient it is difficult to determine whether a developing malocclusion with drift of teeth and probable equilibrium effects is due to an underlying environmental cause like respiratory difficulty, an innate growth dysplasia, or some combination of the two. At best, interceptive possibilities for such patients are limited to that component of the problem which is being caused by an environmental insult. The more the problem is due to innate dysplastic growth, the less likely is any interceptive treatment to succeed. In the example we have been using, improving nasal respiration (by surgical procedures on the nose or nasopharynx) would help only if the patient really had normal growth potential. One should not assume that all, or even most, patients with complex developing malocclusions have this potential.

The chart in Table I is constructed so that interferences with development are arranged in approximate order of complexity from left to right. Note that, in general, eruptive factors are more heavily involved in the simpler problems, while equilibrium effects become more prominent as complexity increases. The same general rule can be applied to preventive and interceptive treatment procedures. Those which relate primarily to eruption of teeth and drift caused by disturbances in dental number are simpler, more reliable, and have a better prognosis than preventive and interceptive treatment aimed at equilibrium factors which interact strongly with skeletal growth.

Definition of Preventive and Interceptive Orthodontics

Once it is accepted that normal growth and development of the dentition is the pivotal issue in gaining normal adult occlusion, then preventive orthodontics can be defined conceptually as "*prevention* of potential interferences with occlusal development," while interceptive orthodontics is defined as "*elimination* of existing interferences with the key factors involved in the development of the dentition." Operationally, preventive orthodontics is any of a set of treatment procedures concerned with keeping potential developmental problems from ever arising. Fluoridation, good restorative dentistry, genetic counseling, and most space maintenance therefore would fall under this heading. Any treatment procedures aimed at eliminating existing interferences with normal development fall under interceptive orthodontics. Since there is often not a clear demarcation between a potential interference and an existing interference, it is only of academic interest to distinguish operationally between preventive and interceptive treatment. Thus, we have considered the two together.

Clinical Experiences with Preventive and Interceptive Treatment

In 1971 at the University of Pennsylvania School of Dental Medicine a decision was made to evaluate the need, demand, and efficacy of preventive and interceptive orthodontics (P & I) in the large child population surrounding the university. This innercity area is characterized by a high percentage of families in low socioeconomic groups to whom orthodontic services traditionally have been almost unavailable. A grant was received from the Haas Community Fund to carry out this project. Details of this study and more complete findings have been published by Freeman[20] who was the Director of the P & I Clinic. We will only be reporting the highlights of those findings in this paper.

An eight chair treatment area in the dental school was designated as the Preventive and Interceptive Orthodontic Clinic; third year dental students were assigned on a rotational basis to the clinic to receive their clinical experience in preventive and interceptive orthodontics. Two chairs were assigned for screening prospective patients. Through this screening the dental students were to learn to recognize and classify developing malocclusions.

The availability of these services was widely advertised throughout the community and over a three-year period 4,200 children were evaluated. The first interesting, although not surprising, finding was that in a "demand" orthodontic population (not referred by dental practitioners) most of the patients appeared with permanent dentitions. Parents usually are not aware of malocclusions in the primary dentition and, in the transitional dentition, either do not recognize the problem or simply hope that it will be self-correcting. Of the 4,200 children seen, only 81 (2 percent) presented with primary dentitions, 1,364 (32 percent) had transitional dentitions, and 2,755 (66 percent) had permanent dentitions. Of the 1,445 children in the primary or transitional dentition, only 66 patients (5 percent) were thought by the examining orthodontist *not* to require treatment. Thus it appears that if parents think that there is a developing malocclusion in the primary or transitional dentition, in 95 percent of the cases they will be right.

Each "screening" patient had a panoramic radiograph taken and a data base for further evaluation was obtained from the film and from clinical examination using the logic of the Ackerman-Proffit orthogonal analysis.[21] All of the evaluation forms were computer coded for ease of data retrieval. Orthodontic faculty members, all of whom received their specialty training at the University of Pennsylvania, decided whether or not the patient was a potential candidate for preventive and interceptive orthodontics and whether complete orthodontic records were to be taken to further evaluate the case.

One of the major initial tasks was to establish operational definitions for identifying patients who might profit from P & I in this clinical setting. The definitions that were adopted required the patient to:
1) have a primary or transitional dentition and thus still be growing actively; 2) have a normal skeletal pattern; 3) have only one of the following major occlusal characteristics af-

fected, alignment, transverse, sagittal or vertical; 4) have a need for only minimal appliance therapy (if fixed appliances were to be used no more than six bands or bonds in either arch); 5) need only a short interval of treatment (not more than one year of active appliance therapy); 6) gain acceptable occlusion at the end of active treatment; 7) not require any additional orthodontic treatment at a later date (i.e., P & I would not be the first stage of two-stage treatment).

Complete orthodontic diagnostic records were obtained for all children who were accepted for treatment in the P & I Clinic. Those patients who had malocclusions not amenable to preventive and interceptive orthodontic treatment were referred to the postgraduate orthodontic clinic for corrective therapy. Some of these patients required early corrective treatment as the first phase of a two-phase treatment plan or serial extractions.

Of the 1,445 potential patients for P & I, only 217 (15 percent) were judged to be good candidates for preventive and interceptive treatment; 1,162 of the 1,445 (80 percent) were judged to need major corrective treatment. Not surprisingly, some patients who were selected for treatment either did not follow through with treatment or did not achieve satisfactory results. Of the 156 successfully treated patients in this project (72 percent of those selected as good candidates), 41 had alignment problems, 42 had sagittal problems, 40 had transverse problems and 26 had vertical problems. The most common treatments rendered were: 1) anterior crossbite correction or correction of maxillary anterior protrusion with spacing, 2) posterior crossbite correction, 3) space maintenance or regaining, and 4) correction of anterior open bite associated with habits.

Discussion

There are several possible reasons for the discrepancy between the large number of possible interceptive procedures (as shown in Table I) and the few types of treatment which actually were rendered. First, some possible situations for P & I arise quite rarely and so were represented only minimally in this sample. Pathologic lesions, ankylosis, congenitally absent teeth and eruption problems had few successfully treated cases due at least partially to this. Second, selection criteria and the prejudices of the faculty for or against certain types of treatment must be recognized. There was no successful treatment of skeletal growth dysplasias because these cases were not attempted. The faculty felt, with good reason, that early treatment might be helpful but that later corrective treatment would be required despite any P & I approaches. Despite these disclaimers, the fact remains that when P & I is an option, the indications are strongly concentrated on relatively few areas.

The distribution of these largely self-referred patients by the type of treatment needed also is interesting. Of the 1,445 children, 66 needed no treatment, 217 were considered candidates for P & I treatment, and 1,162 would need corrective treatment begun in the transitional dentition. Even making a generous allowance for bias and for the tightness of the criteria used in this clinical setting, it is apparent that a majority of the children needed treatment beyond any reasonable definition of P & I since only 15 percent of children were considered candidates.

The only other published longitudinal investigation of this type is the Burlington Study reported by Popovich and Thompson[22] in 1975. Although the selection criteria as well as the treatment methods were somewhat different in the Philadelphia and Burlington samples, the results and conclusions were remarkably similar. In the Burlington study, P & I treatment only was attempted in 18 percent of the 1,258 children who were followed serially. Both at Burlington and in Philadelphia, P & I treatment reduced to three basic types: 1) space maintenance or regaining, related to early loss of primary teeth; 2) habit control, particularly thumb sucking; and 3) crossbite correction, anterior and posterior, to relieve occlusal interferences.

The other potential interferences with development of the dentition either occurred so rarely or were so strongly associated with intrinsic growth dysplasias that treatment was rarely indicated.

In at least some of the countries which have extensive dental health programs, public health officials now feel from their experience that it is less expensive to simply let malocclusions develop fully and then perform corrective orthodontics on a treatment need priority basis.[23] It should be emphasized that these public health officials do not deny that some individuals can indeed profit from P & I treatment. On a population basis, however, it may not be cost effective to emphasize a relatively expensive preventive and interceptive modality which at best can affect 15-20 percent of orthodontic problems and not the most severe ones at that.

As preventive measures for caries control diminish the number of children with early loss of primary teeth, the indication for P & I treatment is being reduced.

These findings also are germane to the issue of how much emphasis should be placed on P & I in the clinical predoctoral program in dental schools. Schools which attempt to operate special clinics in this area may have difficulty in finding enough suitable patients. The Penn statistic of 217 patients selected for P & I out of 4,200 patients screened tells an important story. In addition, recent advances in appliance therapy (bonded pretorqued and preangulated attachments, Nitinol wire, etc.) have rendered obsolete many of the simple removable appliances that were the major armamentarium of P & I treatment. Should P & I be emphasized in the dental curriculum nevertheless?

We have two recommendations for this important point:

1) Attempts to operate a special orthodontic program, offering P & I treatment as the major means of providing clinical experience to predoctoral dental students, should be reviewed carefully in view of these results. When the general dentist is dealing with children, what he knows about the broad spectrum of malocclusion will be more important than what he can do in treatment techniques. Although involvement of clinical orthodontic faculty with dental students and their child patients is needed, there is no reason to overemphasize treatment techniques of limited utility.

2) Orthodontic treatment procedures for patients in the permanent dentition, including adults of all ages, should not be omitted from the predoctoral curriculum in favor of P & I and perhaps in fact should be emphasized. The future general practitioner may be more likely to render a real service with clinical treatment for adults than children.

Summary and Conclusion

The basic concept of preventive and interceptive orthodontics is that interferences with the development of the dentition can lead to malocclusion. Adaptive mechanisms and compensatory growth correct for some developmental aberrations, but in other instances imbalances lead to distortion in dental occlusion. The interrelated processes of eruption, drift and equilibrium determine occlusal relationships, and these processes can be affected in varying ways by a number of well-recognized extrinsic influences. In addition, a lack of synchrony in timing of dental development, skeletal development, and oral-pharyngeal functional development may lead to alterations in the occlusion, temporary or permanent. Theoretically, there could be many opportunities to intervene to correct developing problems.

In an experimental clinical program at the University of Pennsylvania, preventive and interceptive treatment was offered to children when examining orthodontists felt their occlusal problems could be corrected in the primary or transitional dentition with relatively simple treatment. Skeletal growth dysplasia and severe tooth mass-jaw size problems were excluded. Most of the theoretical possibilities for P & I treatment were rarely observed in the clinical setting, and the great majority of the children were judged to require comprehensive orthodontic treatment in the permanent dentition even if treatment was begun earlier. Preventive and interceptive orthodontic procedures, although they have a wide theoretical basis and an appealing rationale, appear unable to successfully manage more than 15-20 percent of developing malocclusions in children. Corrective orthodontics, rather than preventive-interceptive, should be emphasized both in public planning for delivery of care and in dental education.

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Discussion

Dr. E. W. King

This was an investigation to determine the effectiveness of preventive and interceptive procedures in an urban population sample.

If a discussion of a paper is supposed to be provocative and offer a different point of view, there is little with which I can take issue with Doctors Ackerman and Proffit. I should like to offer some comments in regard to their findings. Since the neighborhood from which they derived their sample was an area where most children apparently do not receive routine dental care, then it would appear that in this regard the sample was biased. Obviously, regardless of the type neighborhood from which the patients came, it would be necessary to be selective in regard to such a study. They indicated 15 to 20 percent of the orthodontic problems would be candidates for preventive or interceptive treatment. This seems to me to be high and perhaps would vary depending on the sample. I can only agree that it is a limited number of patients that are candidates for this type of service. But I would put the percentage at closer to 10 percent.

In the listing of criteria for identifying patients who would be in the study, they indicated one of them as *"have a normal skeletal pattern."* When this paper is published I would like to see that particular statement italicized as I feel it is one of the most significant criteria when contemplating interceptive procedures.

The possible environmental factors that may contribute to malocclusion of the teeth were discussed. The interplay of forces, the timing of growth relative to the eruption of the teeth, and the adaptation of form to function and function to form were noted. Then they mentioned eruption, drift and equilibrium as significant factors in the development of the normal dentition. These factors undoubtedly have a role in the development of a normal occlusion or contribute to malocclusion. However, it was stated that "the interplay between inherited and environmental influences makes it difficult to evaluate the relative importance of each." It seems to me that the role of genetic controls exceeds environmental and local factors in the growth and development of the human dentition, severe pathological conditions and injuries excepted. Why do I say this? Simply stated, one from among many reasons is the tendency for some treated malocclusion to "creep" for years out of treatment. Could it be the genetic controls taking over?

The authors excluded from their study arch-length problems and Class II malocclusion for both almost always require comprehensive treatment later. The arch-length problems cannot lend themselves very well to either preventive or interceptive procedures unless we consider serial extraction as such a procedure. Even serial extraction is only a prelude to more comprehensive treatment and unless carefully supervised, where indicated, can work to the detriment of the patient.

Class II, Division 1 malocclusions present many snares and pitfalls involved in their early treatment and most require further treatment later. It is only a very select group and a very small sample of Class II, Division 1 malocclusions in which the malocclusion can be intercepted in the mixed dentition stage.

In conclusion, I want to compliment the authors for calling attention to the realities of preventive and interceptive orthodontics in a time when early and mixed dentition treatment has been a widely publicized means for accomplishing more treatment in less time with less appliance. To be sure, this is the ideal, but I can only agree with the authors that, at present, the realities of the possibilities and limitations inherent within the growth and development of the human face and dentition make such an approach limited at best. Preventive and interceptive orthodontics offer more public appeal than practical irreversible results.