

JL Ackerman
WR Proffit
DM Sarver

The emerging soft tissue paradigm in orthodontic diagnosis and treatment planning

Authors' affiliations:

James L. Ackerman, Private practice,
Bryn Mawr, PA
William R. Proffit, Department of Orthodontics,
University of North Carolina, School of
Dentistry, Chapel Hill, NC
David M. Sarver, Private practice, Vestavia
Hills, AL and Department of Orthodontics,
University of North Carolina, Chapel Hill, NC

Correspondence to:

James L. Ackerman, DDS
931 Haverford Road
Bryn Mawr
PA 19010-3819
Fax: +1 610 5276624
USA
E-mail: ackermanJL@aol.com

Abstract: Until now, orthodontic diagnosis and treatment planning has been based on hard tissue relationships and on the Angle paradigm that considers ideal dental occlusion 'nature's intended ideal form'. In this view, the clinician and nature are partners in seeking the ideal. In the modern biological model, variation is accepted as the natural form; ideal occlusion is the exception rather than the rule, and the orthodontist and nature are often adversaries. The orthodontist's task is to achieve the occlusal and facial outcomes that would most benefit that individual patient, whose esthetic concerns are often paramount. Because the soft tissues largely determine the limitations of orthodontic treatment, from the perspectives of function and stability, as well as esthetics, the orthodontist must plan treatment within the patient's limits of soft tissue adaptation and soft tissue contours. This emerging soft tissue paradigm in diagnosis and treatment planning places greater emphasis on clinical examination of soft tissue function and esthetics than has previously been the case, and new information in these areas is required.

Key words: Angle paradigm; ideal occlusion; relapse; soft tissue

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A universally accepted scientific perspective, the best current explanation of a natural phenomenon, has been termed a paradigm (1). Usually, science advances incrementally by the cumulative effort of investigators, each adding units of knowledge to the currently accepted model or paradigm. A paradigm can be thought of as the foundation upon which a scientific structure is erected, as

if laying brick upon brick of new findings and insights. Scientific progress proceeds in this appositional fashion, until a new way of looking at things arises, and a new paradigm is proposed and accepted. As a new paradigm replaces an old one, today's 'truths' become tomorrow's myths. There is generally great resistance on the part of practitioners of a scientific discipline to acceptance of a new paradigm. Nonetheless, once a paradigm shift has occurred, there is a veritable explosion of new ideas and information, leading to rapid advances in the field.

In orthodontics, at present, we are on the threshold of a paradigm shift that changes the fundamental conceptual underpinnings of orthodontics, and with it, the traditional emphasis in diagnosis and treatment planning. Formerly, the emphasis was on the dental and skeletal components; now, greater attention to the soft tissue aspects of orthodontics is required. For 100 years, orthodontic theory and practice has been largely based on the Angle paradigm (2). This model is predicated on a teleological belief system, which holds that nature intends for all adults to have perfectly aligned dental arches that should mesh in ideal articulation with the teeth in the opposing jaw. When this 'natural' dentitional state occurs, the face should also be in perfect harmony and balance and the stomatognathic system should function ideally. Angle illustrated this idealized view with the skull 'Old Glory' and the neoclassical Greek sculpture of the head and face of Apollo Belvedere (3).

Although Angle's writings were somewhat after those of Darwin and Mendel, it is not evident that he was influenced by these scientists, whose theories would ultimately revolutionize the study of biology in the early twentieth century. Angle's concepts were instead based on those of Bonwill, a nineteenth century dentist, who practiced and taught in Philadelphia during the time that Angle was a student there. Bonwill held that it was ordained for the dental arches and articulation of the teeth to be in perfect alignment, harmony, and function and that these relationships could be described geometrically. His view was that this ideal plan was present from the first creation of life. Bonwill patented the first dental articulator, a device well suited to the mechanical pursuit of an ideal dental relationship. While Bonwill and then Angle were helping to shape dentistry toward a largely mechanical orientation that would last for

much of the twentieth century, Darwin and Mendel were laying the foundation for our understanding of adaptation through natural selection and human variation and for a paradigm shift in dentistry and orthodontics based on a broader view of what is best for a patient than just ideal occlusion.

In the Angle paradigm, the orthodontist, through the use of mechanical regulating devices, attempts to allow an individual to attain 'nature's intended ideal form'. The clinician and nature are partners. In the modern biological model, variation is the theme, and the 'imaginary ideal' is the exception rather than the rule. The orthodontist and nature are often adversaries. An attempt to achieve ideal occlusion for all patients is seen as unnatural. The orthodontist's task is to achieve the occlusal and facial outcomes that would most benefit that individual patient (whose esthetic concerns are often paramount) (4). This goal must be accomplished within the bounds of the individual's ability to adapt physiologically to the morphological changes that have been rendered.

In a sense, all orthodontic treatment outcomes are a compromise between the orthodontist's wishes and nature's demands, particularly in the long run. It has taken a century, not necessarily to learn, but to accept that it is the soft tissues that largely determine the limitations of orthodontic treatment. Orthodontists have traditionally viewed hard tissue structural discrepancies as the major limitation of treatment. In reality, it is the soft tissues that more closely determine therapeutic modifiability. The boundaries of dental compensation for an underlying jaw discrepancy are established by several aspects of soft tissue relationships and function. These include 1) pressures exerted on the teeth by the lips, cheeks, and tongue (5); 2) limitations of the periodontal attachment; 3) neuromuscular influences on mandibular position; 4) the contours of the soft tissue facial mask; and 5) lip-tooth relationships and anterior tooth display during facial animation (6, 7). The physiologic limits of orthodontic treatment (i.e., the ability of the soft tissues to adapt to changes in tooth and jaw positions) are often narrower than the anatomic limits of treatment. In the correction of a severe malocclusion in a growing patient, it is not unusual to produce a change of 7–10 mm in molar relationship overjet or overbite. Yet the tolerances for soft tissue adaptation from an equilibrium, periodontal, TMJ, facial balance,

and anterior tooth display standpoint are often less than half this amount. For instance, in expansion of the lower arch, the envelope is more like 2–3 mm, and it is even less for changes in condylar position.

In some ways, we have had it backwards for 100 years. Nature does not intend for the orthodontist to achieve perfection, but rather it contends with the orthodontist trying to achieve perfection. We must abandon the traditional Aristotelian 'either/or' view that the outcomes of orthodontic treatment are either successes or failures based on the standard of ideal occlusion. Orthodontic results should be evaluated on the basis of overall benefit to the patient and viewed as a continuum rather than a single specific end point. Treatment 'failures' are generally the result of poor treatment response rather than inadequate treatment, and treatment response is also, to a great extent, determined by the soft tissues. Rather than designating orthodontic treatment outcomes as successes or failures, patients should be classified as responders and non-responders. Similarly, since post-treatment 'relapse' is physiologically determined, post-retention patients should be characterized as adapters and non-adapters. Using this construct, the orthodontic patient population can be represented by a bell-shaped curve, with the most favorable responders and adapters at one end and the most unfavorable at the other end. Those patients who, in the past, were presented as the most dramatic successes and failures were merely the outliers on a normal distribution curve. Any individual's position on that curve will be determined, to a great extent, by soft tissue influences on the treatment process and outcome.

Thus, it is the orthodontist's task in diagnosis and treatment planning to ascertain an individual's available limits of soft tissue adaptation, given the dental and skeletal changes that the orthodontist and the patient would like to create. Although, at the present time, quantitative measurements cannot be rigorously applied for soft tissue assessment, the challenge for the future will be to develop methods for doing so. This will codify the biologically driven paradigm that will better serve orthodontics for the twenty-first century.

The new paradigm in no way diminishes the efficacy or value of orthodontic treatment for most patients. It may challenge the long-term effectiveness of

certain types of therapy for some patients. With this new concept, as with the old, orthodontic treatment will continue to provide functional and esthetic benefit to patients. Admittedly, the mission of the orthodontist may no longer be divine (i.e., carrying out nature's plan), but instead will merely be human, so it will be easier to acknowledge that, to a certain extent, we will err. In a sense, the divine role, forgiveness, now is played by the soft tissues. Nor is the new paradigm an excuse for less careful orthodontics. It does, however, remove some of the self-blame and doubt that orthodontists have typically had after their best efforts have resulted in imperfect results. The myth of the orthodontic ideal has been perpetuated by presentations at meetings and in the literature of patients who overwhelmingly have been the favorable treatment response outliers. Our focus needs to be on the shape of the distribution curve and the chance that a particular patient will have a favorable or unfavorable response with a particular treatment procedure.

This paradigm change is initially unsettling for at least two reasons: 1) it is revolutionary, in that it represents a significant philosophical turn in our orthodontic conceptual framework; and 2) documentation (records and their measurement) has been and needs to remain the key element in orthodontic diagnosis and treatment planning. Since we do not yet have as good physiologic probes for evaluating the soft tissues as we have morphometric tools for measuring dental and skeletal components, it places greater emphasis on the physical examination of the patient than orthodontists have previously been accustomed to. If soft tissue function and soft tissue esthetics are more important than we previously acknowledged, there is no choice but to become more aware of both areas. Because a new paradigm stimulates the generation of new knowledge of a type that was not sought before, we should expect appropriate new information to be developed rapidly.

Perhaps it is fitting that for orthodontics, a diagnostic paradigm shift accompanies the turn of the century. The twenty-first century will certainly see a new emphasis on soft tissue relationships in orthodontic diagnosis and treatment planning and a greater acknowledgement of biologic variation in determining treatment outcomes.

Abstrakt

Bis heute basierten kieferorthopädische Diagnose und Behandlungsplanung auf das Verhältnis des Hartgewebes und auf dem Angle-Paradigma, welches die ideale Okklusion als 'die von der Natur beabsichtigte Idealform' ansieht. In dieser Hinsicht sind Kliniker und Natur Partner bei der Suche nach dem Ideal. Im modernen biologischen Modell werden Variationen als die natürliche Form akzeptiert, eine ideale Okklusion ist eher die Ausnahme als die Regel, und der Kieferorthopäde und die Natur werden oft zu Gegnern. Ziel des Kieferorthopäden ist es, die für den individuellen Patienten mit oftmals prioritären ästhetische Bedenken optimalen Okklusions- und Gesichtsergebnisse zu erreichen. Da das Weichgewebe im weiten die Grenzen einer kieferorthopädischen Behandlung von der Funktion und Stabilität sowie auch der Ästhetik her festlegt, muß der Kieferorthopäde seinen Behandlungsplan innerhalb der Grenzen der Anpassungsfähigkeit und der Kontur des Weichgewebes erstellen. Das daraus entstehende Weichgewebe-Paradigma in Diagnose und Behandlungsplan legt einen größeren Schwerpunkt auf die klinische Untersuchung der Funktion und Ästhetik des Weichgewebes als dies bisher der Fall war und benötigt neue Informationen in diesen Bereichen.

Resumen

Hasta hoy, el diagnóstico ortodóntico y el plan de tratamiento han sido basados en relaciones de tejidos duros y en la paradigma de Angle, que considera la oclusión ideal dental 'la forma ideal por naturaleza.' Desde este punto de vista, el clínico y la naturaleza son socios al perseguir este mismo ideal. En un modelo biológico moderno, variaciones son aceptadas como la forma natural, la oclusión ideal, es la excepción en vez de la regla, y el ortodoncista y la naturaleza son adversarios frecuentes. El trabajo del ortodoncista es el de lograr la finalidad facial y oclusal que más beneficie al paciente, cuyas preocupaciones estéticas son usualmente lo más importante. Debido a que el tejido blando determina mayormente las limitaciones del tratamiento ortodóntico, desde la perspectiva de función y estabilidad al igual que en lo estético, el ortodoncista debe planificar el tratamiento entre los límites de la adaptación y el contorno del tejido blando. Este paradigma, de creciente importancia en el tejido blando, en la planificación del diagnóstico y tratamiento, ocupa mayor énfasis en el examen clínico de la función y estética del tejido blando que en casos anteriores y requiere información nueva en estas áreas.

抄録

矯正学的な診断や治療計画は、これまで、硬組織の関係や、理想咬合を“自然の理法によって定められた理想の形 (nature's intended ideal form)”とみなすアングルの方法に基づいて行われてきた。理想を探求するという点で、臨床医と自然の理法はパートナーである。現代の生物学的方法においては、多様性も自然な形として受け入れられ、理想咬合は、常例というよりもむしろ例外である。そして、矯正医と自然の理法はしばしば利害の対立する関係となる。矯正医の職務は、審美性がしばしば最重要事項である個々の患者のために、咬合と顔貌の最良の結果を達成することである。たいていの場合、軟組織が矯正治療の限界を決定することになるので、矯正医は、審美性と同様に機能と安定性から、患者の軟組織の適応と輪郭の限界内で治療計画を立てなければならない。診断ならびに治療計画をたてるうえで、この軟組織を把握する方法は、軟組織の機能と審美性の臨床検査法において、これまでに行われてきたものよりも大きな重要性をもち、この分野での新たな情報を必要とする。

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