Evaluation of orthodontic results — a discussion of some methodological aspects

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The evaluation of treatment results in various fields of medicine is frequently based on the consideration of the following aspects: a) success or failure rates; b) degree of improvement or aggravation; c) result as related to the time factor; d) result as related to the cost factor. In orthodontic treatment, the study of these aspects has received little attention.[1] In fact, the presentation of successful and, frequently, highly selected treatment results has great tradition in orthodontics.[2,3,4,5]

The intention of this paper is to contribute to the discussion of the following topics: criteria for evaluation of orthodontic treatment results; the selection of cases to be evaluated; the presentation of orthodontic treatment results; and the recipient's interpretation of case presentations.

Criteria for the evaluation of orthodontic treatment results.

In evaluating orthodontic treatment results, the following criteria are relevant:

1. Occlusion
2. Function of the stomatognathic system
3. Esthetics
   a) Orthodontist's opinion
   b) Patient's opinion
4. Stability
5. Iatrogenic treatment effects

Occlusion

A number of definitions can be found in the literature describing the terms "ideal," "normal" or "optimal" occlusion. The range of difference between the concepts is evident: Ramfjord and Ash[6] described 26 occlusal contacts while Hellman[7] described 138. Mohl, Zarb, Carlson and Rugh[8] listed 20 criteria for ideal occlusion in addition to what they described as "classical" anatomical relationships between the dental arches. In orthodontically treated patients, Andrews[3] found that a great number of the 1150 successfully treated American Board cases did not fulfill the requirements of one or more of his "six keys to normal occlusion." Also, be-

Abstract

The informative value of clinical material presented at meetings and in the literature poses a dilemma for the typical orthodontist. To aid in the resolution of this problem, methodological aspects of the following topics are discussed: criteria for the evaluation of orthodontic treatment results, the selection of cases to be evaluated, the presentation of orthodontic treatment results and the interpretation of case presentations. Orthodontic relapse should be considered to be a number of continuous variables affecting treatment results; different follow-up criteria should be employed when comparing pretreatment, posttreatment and postretention results.

This manuscript was submitted and accepted for publication January 1991.

Key Words

Case selection • Case presentation • Evaluating treatment results

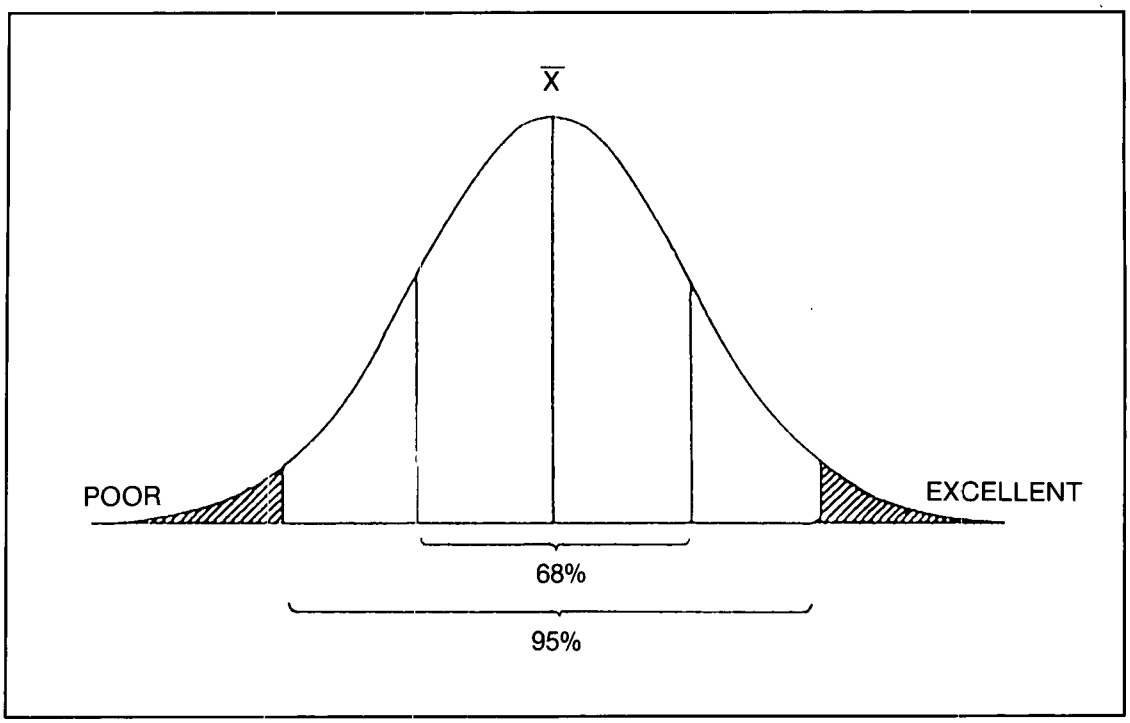

Figure 1
Hypothetical normal distribution of orthodontic treatment results based on a score system in a prospectively selected group of cases.

cause tooth size varies, there is evidence to believe that "ideal" occlusion as a result of orthodontic treatment is more often the exception than the rule. Because of the complexity connected with achieving an ideal occlusion it might be advantageous, for the sake of communication in orthodontic literature, to quantify occlusion as a score value or percentage of the ideal. The quantification of occlusion has parallels in medicine, for instance in general orthopedics, where the degree of restitution of handicap frequently is expressed as a percentage of the ideal.

Function of the stomatognathic system

Epidemiological studies have shown that there are more people with some kind of deviating tooth position than people with functional disorders of the stomatognathic system.[10-13] The symptom-free interrelationship of form and function, even under conditions markedly deviating from the ideal, is frequently observed. This, however, should not lead to a practice of disregarding basic functional principles of treatment.

The gradual adaptation of muscles and joints to the slow development of a specific occlusion during growth might not occur following a much quicker change related to orthodontic treatment. This is especially true with adults. For the sake of evaluation and comparison, a list of criteria for orthodontic treatment results should include registration of the functional situation, with specific reference to functional disorders of the stomatognathic system.

Esthetics

The existence of a variety of methods for evaluating facial esthetics is an indication of the close relationship between orthodontics and esthetics. However, any judgment of facial esthetics is subjective, depending upon cultural, social, geographical, psychological and racial backgrounds. A method of scoring should include both esthetic and psychological aspects specifically related to patient's self-perception. Regarding dentofacial characteristics, this appears to be a highly variable parameter.[14,15,16,17] One general risk of relying on any score system in this field is the appearance of reduced sensitivity in evaluating the individual patient. A very simple grading system might prove to be more useful than a complex index evaluating a large number of variables.

Stability

An increasing amount of research and clinical data indicate that the stability of orthodontic treatment results has to be looked upon as a relative characteristic both in relation to time and morphology.[18,19]

With this in mind, what should be considered a reasonable time after the end of retention to assess "long-term stability"? In relation to the cost, duration and effort invested in orthodontic therapy, 1 or even 5 years is not very long. On the other hand, expecting a high degree of stability after 20 years exceeds the usual expec-

Figure 2A

Figure 2B

Figure 2A-B
Skeletal openbite. Case could be related to Figure 1, left tail of the curve. A: Before unsuccessful treatment with Edgewise and vertical elastics. B: After treatment.

Figure 3A

Figure 3B

Figure 3A-D
Dentofacial openbite which could be related to the majority group of Figure 1. Slow reaction to treatment and the occurence of slight root resorption led to acceptance of result. A-B: Before treatment. C-D: One year out of retention.

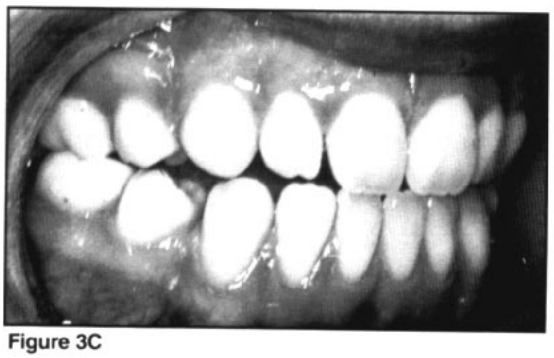

Figure 3C

Figure 3D

tations in other fields of medicine and dentistry. One must also consider other long-term changes of the dentition due to growing, aging, periodontal disease and caries, as well as various types of dental restorations. As interesting as it might be to follow dentofacial development life-long, analyzing orthodontic treatment results 10 years out of retention seems to be nearly ideal.

Should the criteria applied at the end of retention also be used for follow-up evaluation? The answer should be seen in a larger context. It seems reasonable to apply a similar approach to postretention patients as is used when assessing the need for orthodontic treatment of a new patient.[14,15,16,17] Occlusion and malocclusion have been described as continuous variables, and so should the term "relapse." It is widely accepted in the society that a great number of people having minor malocclusion are not in need of orthodontic treatment.[20,21]

Research findings indicate that 35% to 40% of Caucasians may fall into this category.[11,13,20,22,23] Presumably, the amount of relapse in a great number of cases may result in only minor malocclusion.

In other words, at the end of treatment the patient has the right to have received a treatment result as individually optimal as possible. It might be more biological, however, not to apply the same requirements, after some years of physiological adaptation to the orthodontically established occlusion. In view of the present state of knowledge it might also be overly ambitious, overly optimistic and unrealistic in many patients.[17]

There appears to be a need in the orthodontic community for a kind of consensus on the evaluation criteria to be applied after the cessation of retention. These criteria may be more closely related to the "no need for treatment" than they are to the "end of treatment" criteria.

Iatrogenic treatment effects

A list of criteria related to treatment results cannot be considered complete without the reg-

istration of possible iatrogenic treatment effects: enamel lesions, marginal bone loss and apical root resorption.[24,25] Apical root resorption has frequently been referred to as the Achilles heel of orthodontics. However, the relationship between root length and longevity of a tooth is still nebulous. Some clinical observations have shown that teeth with very short roots can function well for many years.

The selection of cases to be evaluated

In evaluating orthodontic treatment results, the procedures employed to establish a sample are of fundamental importance.

It is a basic statistical principle that a sample should be as representative as possible in order to draw generalized conclusions. From that point of view, prospective case selection would be the best approach. Prospective selection involves establishing a sample before undertaking any treatment procedures and giving each case of a specific category an equal chance of being included in the sample. However, in prospective case selection, the drop-out problem may have a strongly reducing effect upon the size of the sample. Prospective case selection is not a guarantee against bias: it is, for instance, mandatory that the selection is not made from cases that seem to be particularly well-suited for the actual treatment method to be studied.

In retrospective case selection, patients whose treatment had to be discontinued, for instance due to insufficient cooperation, are frequently excluded. The argument for doing so may be that patients cooperating poorly are of little interest when studying orthodontic results, since adequate cooperation is a prerequisite for orthodontic treatment. However, the exclusion of some problematic patients has a biasing effect upon the sample in that the more successful part of the story is being reported. The implication of bias connected with retrospective case selection might be of specific significance, for instance when comparing treatment methods demanding different amounts of cooperation.

Some papers are based on the analyses of cases that are reported to have been treated consecutively, implying a true reflection of the treatment panorama. However, it might be of some importance to know whether or not the cases were consecutively started or consecutively finished. The term "consecutively treated" does not necessarily always mean the same thing.

The term "selected at random" sounds very reassuring since every case of a larger material would have an equal chance of being included in the sample. However, the previous question raised also has validity here: Is the selection at random based on started or finished cases?

In anecdotal case selection no analysis of a group makes up the basis for the study. Obviously this may greatly influence the informative value of a report. However, much depends on how typical the demonstrated cases are and which conclusions are being drawn. Much has been learned in orthodontics from good anecdotal case reports, so the term "anecdotal" does not deserve to be too negatively loaded. If, however, the cases demonstrated are exceptionally good — for instance one out of one hundred — generalized conclusions might be more misleading than informative.

The presentation of orthodontic treatment results

If an orthodontist, who can look back on a decade or more of well-documented clinical practice, receives an invitation to present, for instance, orthodontically treated openbite cases he might face a situation as illustrated in Figure 1: Available scientific and clinical data indicates that a sample of a certain size will contain some excellent treatment results, some poor, and a great number of cases lying between the two extremes. The distribution is, of course, not necessarily the illustrated normal one; this will depend on the selection criteria, the grading system, the severity of the cases to be analyzed, the treatment method and the capability of the orthodontist.

When deciding which cases to demonstrate, several possibilities exist:

a) Present some of the poorest results with the claim that one learns the most from problems and failures (Figure 2). The attendees might not be impressed, but many of them will recognize the clinical situation.
b) Present cases selected from the big majority group, according to Figure 1, to give the truest reflection of the results most frequently achieved (Figure 3). However, since the results are not among the most excellent ones, the impression given may be that the clinician has been able to obtain treatment results of only mediocre standard.
c) Present some of the best results, as in Figure 4. This can be very inspiring to the audience. Of course, some fine results tell much about the excellence of the method and the operator. However, as these results may not be representative for the group analyzed, a skewed picture might arise, if the situation is not clearly explained. It is the opposite of scientific methodology to draw generalized conclusions from extreme observations.

Figure 4A

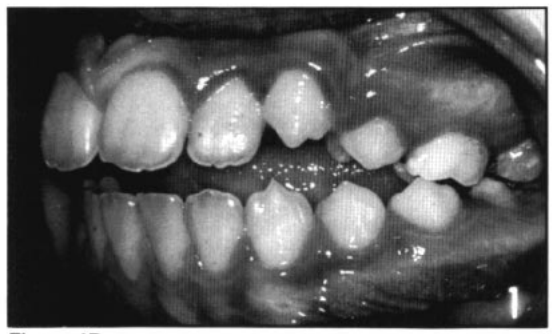

Figure 4B

Figure 4A-F
Dentofacial openbite. Example of good treatment result which could be related to Figure 1, right tail of curve. A-B: Before treatment. C-D: After treatment. E-F: 2½ years out of retention.

Figure 4C

Figure 4D

Figure 4E

Figure 4F

Another possibility is to present cases from all three categories (Figures 2-4), which would give a truer picture of the treatment response. Selection with the help of random digits or by drawing lots is another option in order to give each case an equal chance of being included in the presentation.

The recipients' interpretation of case presentations

In the past a large number of case reports, not necessarily representative, have been presented at orthodontic meetings and in orthodontic texts; it is not unrealistic to presume that this will continue in the future. What can the reader, the course-goer or congress attendee do in order to assess the value of the information being presented?

An antenna of a psychological nature might be useful. By the help of this antenna one might try to pick up the main tune of the presentation. Further, the underlying method of selecting the cases presented is another basic source for the assessment.

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