Determining the limits of orthodontic treatment of overbite, overjet, and transverse discrepancy: A pilot study

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Introduction: Because of the severity of some malocclusions, it is not always possible to treat them without a combination of orthodontics and orthognathic surgery. However, many insurance carriers have difficulty in deciding whether such treatment should be covered. The purpose of this study was to develop a simple method that can be used by insurance carriers to determine when a malocclusion is not correctable by orthodontics alone. Methods: Twenty-eight orthodontists independently evaluated 30 sets of pretreatment dental models (10 with overjet from –6 to 12 mm, 10 with overbite from 60% to 100%, and 10 with transverse discrepancies from single tooth to total arch crossbite) to determine whether the conditions were orthodontically treatable. They were instructed to assume that growth was complete and that the treatment would not seriously compromise facial esthetics. Results: It was the opinion of the orthodontists that a positive overjet greater than 8 mm, a negative overjet of 4 mm or greater, and a transverse discrepancy greater than 3 mm were not orthodontically treatable. However, most orthodontists believed that they could treat all overbite patients without surgery. Conclusions: These data can serve as a simple guideline for helping insurance carriers determine the need for orthognathic surgery. (Am J Orthod Dentofacial Orthop 2006;129:804-8)

Oral and maxillofacial surgeons have performed orthognathic surgery to correct skeletal related malocclusions for many years. During this time, the specialty has advanced this field of surgery to a high degree of both predictability and stability. The problem, however, is that some insurance companies don’t cover the costs of this surgery, even though these procedures have functional benefits for the patient.1-5 The reasons for this are often related to the surgery not meeting the insurance companies’ specific criteria for medical necessity. However, some criteria have not been altered for many years and are often unrealistic by today’s standards—eg, malnutrition or documented speech pathology.

Because skeletal discrepancies and the associated malocclusions can cause functional problems, correction of these malocclusions is important.1-8 Thus, the appropriate criterion for determining coverage for orthognathic surgery should be whether or not the condition is orthodontically correctable.

There have been previous attempts to quantify the need for orthodontic treatment, and several indexes are used for determining access to publicly funded orthodontic services.9-12 However, these studies intended only to determine whether a patient would benefit from orthodontic therapy without considering surgical correction as a treatment option. Proffit and White12 developed an “envelope of discrepancy” for the jaws, describing the limits of orthodontic tooth movement alone and the limits of change possible with a treatment plan including both orthodontics and orthognathic surgery. In this model, they suggested 2 and 5 mm as the maximum amounts of forward orthodontic tooth advancement possible for maxillary and mandibular anterior teeth, respectively. They also suggested that the maximum amounts of anterior tooth retraction possible were 7 and 3 mm for the maxilla and mandible, respectively. However, they noted that these values are only guidelines and might overestimate or underestimate the possibilities for any given patient.

The purpose of this pilot study was to determine whether there is general agreement among orthodont-
tists about the limits of orthodontic therapy for correcting skeletally related malocclusions. If so, these data could then be the basis for an algorithm to be used by insurance companies in determining coverage for orthognathic surgery.

**MATERIAL AND METHODS**

We examined 3 important measures of occlusion: overjet, overbite, and transverse discrepancy. Ten sets of pretreatment dental models were selected for each parameter to be evaluated from patients treated either orthodontically or with combined orthodontics and orthognathic surgery in the Department of Orthodontics at Virginia Commonwealth University. The 10 sets representing the overjet category ranged from −6 to 12 mm, the 10 sets representing overbite ranged from −60% (open bite) to 100%, and the 10 transverse sets ranged from a single-tooth crossbite to a total-arch crossbite.

The 30 sets of models were given to the orthodontists with the following instructions: “independently assess each set of models only for the indicated parameter and, based on the amount of that discrepancy, indicate whether the condition is orthodontically treatable or if orthognathic surgery would also be necessary.” For all cases, the orthodontists were instructed to “assume that growth was complete and that the treatment would not seriously compromise the facial esthetics.” The orthodontists were given no other sources of diagnostic information such as radiographs or clinical photographs, and no measuring devices such as rulers or calipers were provided. The respondents indicated their “yes” (orthodontically treatable) or “no” (orthognathic surgery) replies on answer sheets.

Twenty-eight orthodontists completed this study, and their answers were totaled for each set of 10 models. The data were then statistically analyzed by using logistic regression to relate the amount of each discrepancy to the probability that the patient could be treated orthodontically.

**RESULTS**

In the overjet category, the relationship between the percentages of “yes” and “no” answers and the amount of overjet is shown in Table I and Figure 1. The relationship with the amount of overjet showed a significant increase and then a decrease ($P = .0088$). With negative overjets of 4 mm or greater (mandibular prognathism), all answers were “no.” Because there were no models to evaluate an overjet between −4 and +3, it was not possible to determine the exact point at which the transition from “no” to “yes” answers occurred. However, at +3 mm, the percentage of “yes” answers was 93%, and it reached 100% at +4 and +5 mm of overjet, remaining high until +8 mm, when it began to decrease.

In the overbite category, the relationship between the percentages of “yes” and “no” answers and the amount of overbite is shown in Table II and Figure 2. There was no evidence for a relationship ($P = .3280$). With the exception of the set of models with an anterior open bite (−60%), the set with 0% overbite, and the set with 100% overbite, there was almost unanimous agreement that these patients were orthodontically treatable.

In the transverse discrepancy category, the relationship between the percentages of “yes” and “no” answers and the amount of transverse discrepancy is
As can be seen in Figure 3, there was a linear relationship, with the percentage of “yes” answers generally decreasing as the amount of transverse discrepancy increased beyond 3 mm, although the percentage agreement varied widely.

**DISCUSSION**

The results of this study showed 100% agreement among the orthodontists that an overjet of −4 mm or more is not correctable by orthodontic treatment alone. Because no negative overjet examples less than −4 mm were included in the study, it was not possible to determine whether these patients could be treated without surgery. However, based on the “envelope of discrepancy” of Proffit and White, it appears that these patients can be treated orthodontically. Future studies should include more examples of mild negative overjet to determine specifically at which point orthodontists believe surgery is not necessary.

With overjets between 3 and 10 mm, there was greater than 90% agreement about the effectiveness of orthodontic treatment alone. However, with overjet values greater than 10 mm, the agreement among the orthodontists fell below 90%. The lower 95% confidence interval on the predicted value for the 10-mm overjet example was only 82% (Table I). This means that if the study was repeated with 28 different orthodontists, the 90% agreement found for the 10-mm example in this study could be as low as 82%. Therefore, if 90% agreement is the chosen confidence level, 8 mm is the limit at which the orthodontists believe that

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**Table II. “Yes” answers (orthodontically treatable) for overbite**

<table>
<thead>
<tr>
<th>Overbite (%)</th>
<th>Count</th>
<th>Percentage “yes”</th>
<th>95% CI</th>
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<td>−60</td>
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<tr>
<td>100</td>
<td>18</td>
<td>10</td>
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</table>

**Table III. “Yes” answers (orthodontically treatable) for transverse discrepancy**

<table>
<thead>
<tr>
<th>Transverse amount (mm)</th>
<th>Count</th>
<th>Percentage “yes”</th>
<th>95% CI</th>
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<tr>
<td>5.0</td>
<td>10</td>
<td>18</td>
<td>36</td>
</tr>
</tbody>
</table>

**Fig 2.** Relationship between amount of overbite and percentage of respondents who indicated that, “yes,” it was orthodontically treatable. Observed percentage values are shown as dots, and predicted percentage of “yes” answers is shown by solid line; 95% confidence interval on predicted value is also shown.

**Fig 3.** Relationship between amount of transverse discrepancy and percentage of respondents who indicated that, “yes,” it was orthodontically treatable. Observed percentage values are shown as dots, and predicted percentage of “yes” answers is shown by solid line; 95% confidence interval on predicted value is also shown.
surgery was not a necessary adjunct to orthodontic therapy.

In the overbite group, the results showed no statistical relationship between the probability of a “yes” response and the amount of overbite. In patients with overbites between 5% and 90%, there was almost universal agreement that they could be treated orthodontically. The 2 sets of models that led to the equivocal results were the 0% and 100% overbite examples. In these extreme cases, most orthodontists (64%) still thought that they could treat the malocclusion with orthodontic therapy alone.

Only 1 case of anterior open bite (−60%) was included in the overbite category. Although there is no explanation as to why 8 orthodontists believed that they could treat such a severe case without surgery, 71% of the respondents thought that surgery would be required; this agrees with the generally held opinion that such skeletally related malocclusions need to be treated by LeFort I osteotomies with posterior impaction.13 Future studies on related malocclusions need to be treated by LeFort I.

The transverse discrepancy group showed a statistically significant linear trend. As the amount of transverse discrepancy decreased, the proportionate number of “yes” responses increased. However, both the predicted and lower 95% confidence interval values were low. The reason for this seemed to arise from the difficulty in quantifying the transverse discrepancy uniformly. Some transverse issues are related to dental tipping of at least 1 tooth, but others are a skeletal growth problem. Clearly, the chosen treatment for a transverse discrepancy depends on the underlying problem. In our sets of models, there were examples ranging from a single tooth in crossbite due to dental tipping to a full-arch crossbite due to maxillary skeletal constriction. Future studies should perhaps divide the transverse discrepancies into 2 separate categories: dental tipping and skeletal growth constriction, because the former category is generally orthodontically treatable, but the latter often requires orthognathic surgery.

Although the number of “yes” responses in the transverse discrepancy group showed a significant increase as the amount of discrepancy decreased, there was inconsistency in the orthodontists’ evaluation of a set of models in the 2.0 and 5.0 mm categories (Table III). A possible explanation for the orthodontists’ selection of orthognathic surgery in the 2-mm case might have been related to the minimal overbite, so that any tipping of the teeth orthodontically would most likely cause occlusal interference and development of an anterior open bite. In the 5-mm case, the patient had an irregular omega-shaped arch form so that some orthodontists might have thought that the transverse discrepancy would improve by aligning the teeth orthodontically.

This pilot study was designed to determine orthodontists’ opinions about the limits of orthodontic treatment alone for correcting overjets, overbites, and transverse discrepancies. Although some limits appear to be well defined in this study, others remain unclear because of the lack of uniformity in the sequential differences of the models in each series. Because of the difficulty in obtaining models to show consecutively graded differences, future efforts designed to build on this pilot study should probably use simulated computer models that incrementally increase the degree of malocclusion.

CONCLUSIONS

Based on the results of this study, it appears that mature patients with positive overjets greater than 8 mm or negative overjets of −4 mm or greater are not treatable with orthodontic therapy alone. Likewise, treatment of a transverse discrepancy greater than 3 mm or an anterior open bite also requires orthognathic surgery. However, in patients with overbites between 0% and 100%, most orthodontists believed that they could treat these patients orthodontically.

REFERENCES


