SPECIAL ARTICLE

A comparison of outcomes of orthodontic and surgical-orthodontic treatment of Class II malocclusion in adults

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The treatment outcome for skeletal Class II malocclusion was reviewed in 33 nongrowing patients who were treated with orthodontics alone (by premolar extraction and tooth movement to camouflage the skeletal problem) and in 57 patients treated for similar problems with surgery and orthodontics (with mandibular advancement and with tooth movement to reduce rather than increase dental compensation for the skeletal deformity). Cephalometric and dental cast changes were scored to quantitate treatment effects. Two approaches were used to detemine the treatment efficacy (the relative success of treatment): (1) whether the final value for a measurement criterion (such as an overjet and an ANB angle) fell within the normal range, and (2) the quantitative amount of correction produced relative to an "ideal" value. In addition, a panel of judges was used to rate esthetic changes from pretreatment and posttreatment facial slides. Both orthodontic treatment and surgical-orthodontic treatment improved the malocclusion as judged from dental casts. Surgery resulted in greater reduction of overjet and greater improvement in most cephalometric skeletal, dental, and soft tissue criteria. Before treatment, the surgical patients had lower esthetic ratings than the orthodontics-only patients. After treatment, the esthetic ratings for the orthodontic patients were unchanged. The surgical patients had improved but not to the pretreatment level of the orthodontics patients. (Am J Orthod Dentofac Orthop 1992;101:556-65.)

There are three possible approaches to the treatment of skeletal Class II malocclusion: (1) modification of growth so that the jaw discrepancy is reduced or eliminated as the mandible grows more than the maxilla; (2) tooth movement to compensate for the jaw discrepancy, i.e., retraction of the upper incisors or proclination of the lower incisors. The effect is to camouflage rather than to correct the skeletal problem; or (3) surgical repositioning of the jaws, which almost always involves mandibular advancement because severe Class II malocclusion is overwhelmingly due to mandibular deficiency.[1] To the extent that growth modification is possible, this is the ideal treatment. Orthodontic treatment in children and adolescents is based on a combination of growth modification and camouflage. Some favorable growth nearly always is observed in the younger patients in whom excellent results are obtained, even when treatment is done relatively late in the growth period.

However, for late adolescents and adults in whom significant growth no longer will occur, camouflage and surgery are the only treatment possibilities. Which of these is the "better" approach is highly controversial, in part because so little comparative data exist at present. The effects of surgical versus camouflage treatment can be measured in terms of the clinical outcomes produced by the treatment, i.e., the changes in dental occlusion, cephalometric measures, and esthetic judgments that occur. These have been discussed in the context of case reports by Poulton and Ware[2,3] and by McNeill and West[4] but have not been reviewed systematically in groups of patients.

When comparing the alternative treatment procedures, it also is important to evaluate treatment efficacy, which is determined by whether and to what extent the treatment met its goals of improving dental relationships and dentofacial esthetics. Although no such comparison of treatment efficacy has been previously published, it seems reasonable to calculate it in terms of the goals of modern orthodontics, which are normal occlusion, acceptable skeletal and soft tissue proportions, and acceptable dentofacial esthetics. Additional goals are a reasonably stable result and good risk-benefit and cost-benefit ratios.

In contrast to the highly developed and straightforward methods that orthodontists routinely use to eval-

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This project was supported by NIH Grant DE-08708 from the National Institute of Dental Research.
8/1/27838

Table IA. Pretreatment characteristics of subjects

	Orthodontics only n = 33		*Surgery-orthodontics n = 57*	
	Mean	*SD*	*Mean*	*SD*
Age	22.2	6.1	30.5	9.8
Treatment Time (mos)	24.0	—	30.0	—
Overjet	6.6	3.0	9.0	2.4
ANB	5.1	1.4	5.8	2.0
Mandibular plane angle	34.0	7.0	32.2	7.5

uate dental occlusion and dentofacial proportions, the evaluation of dentofacial esthetics is unstandardized. The normal dentofacial proportions established by cephalometric standards correlate with esthetic judgments[5,6] but are not adequate by themselves for complete evaluation of the esthetic component of treatment.[7] Experience has shown, however, that groups of judges can consistently score facial photographs, and this approach allows a reasonable evaluation of esthetics.[8,9]

This article presents data from a retrospective study of the effects and efficacy of orthodontic (camouflage) versus surgical-orthodontic treatment of skeletal Class II malocclusion in nongrowing patients.

METHODS

Subjects. Subjects were selected from treatment records available at the University of North Carolina. The records to be analyzed (dental casts, cephalometric radiographs, photographs) were taken immediately before treatment and within 1 year of completion of the orthodontic phase of treatment.

For the orthodontics-only group, 136 patients were identified whose clinical notes indicated treatment for Class II malocclusion beginning at age 17 years or older. Of these patients, 52 were rejected because the sequential cephalometric radiographs showed jaw growth during treatment, 40 because analysis of the initial cephalometric film showed that they were dental but not skeletal Class II, and 11 because of incomplete or poor quality cephalometric records. Cephalometric changes were assessed in the remaining 33 patients, but dental casts were available for only 23 patients.

For the surgical group, 73 patients were identified in whom mandibular advancement surgery alone (without maxillary, dentoalveolar, or chin surgery) had been accomplished. Of these patients, 9 were rejected because jaw growth occurred during treatment, and 7 because the records were incomplete or of poor quality. All the remaining 57 patients were used to assess cephalometric changes. Pretreatment and posttreatment dental casts were available on only 19 patients since the orthodontic treatment for many patients was performed in their local community and only the surgery was performed at the university.

Subject characteristics before treatment are summarized in Table I. The groups were similar. On average the surgical patients were slightly older and had longer treatment times. They also had greater overjet and somewhat more severe mandibular deficiency. Of the orthodontics-only patients, five were treated with the Begg appliance.

Table IB. Pretreatment characteristics of subjects

	Orthodontics only	*Surgical-orthodontics*
	Relative frequency (%)	*Relative frequency (%)*
Female	68	73
Class II, Division 2 malocclusion	32	29
Extractions	91	38
Edgewise Appliance	85	100

Determination of treatment effects. To assess changes in the dental occlusion produced by treatment, the occlusal characteristics included for evaluation in the 1990 N-HANES III survey of the United States population were employed.[10] On the pretreatment and posttreatment dental casts, Little's irregularity index[11] was calculated for both the maxillary and the mandibular incisors. Overjet was measured as for N-HANES III. In addition, buccal interdigitation was scored as the horizontal distance from the buccal cusp tip of the upper second premolar to the contact point between the mandibular first molar and second premolar. A positive score (maxillary cusp tip anterior to the mandibular contact point) indicated the extent of Class II interdigitation, a negative score indicated the extent of Class III interdigitation (the magnitude of "Class II windows" or "Class III windows" in the occlusion). The presence or absence of crossbite was scored, and intermolar and intercanine widths, as well as overbite and open bite, were measured. For each characteristic, treatment effect was recorded as the change from before to after treatment (Table II).

For cephalometric evaluation, pretreatment and posttreatment cephalometric radiographs were digitized. A coordinate system was established, with a line through sella rotated 6° down anteriorly from the SN line as the horizontal axis, and a vertical line through sella perpendicular to it as the vertical axis. Millimeter changes in landmark positions were recorded as coordinate changes in this reference system; angular measurements also were employed (Fig. 1).

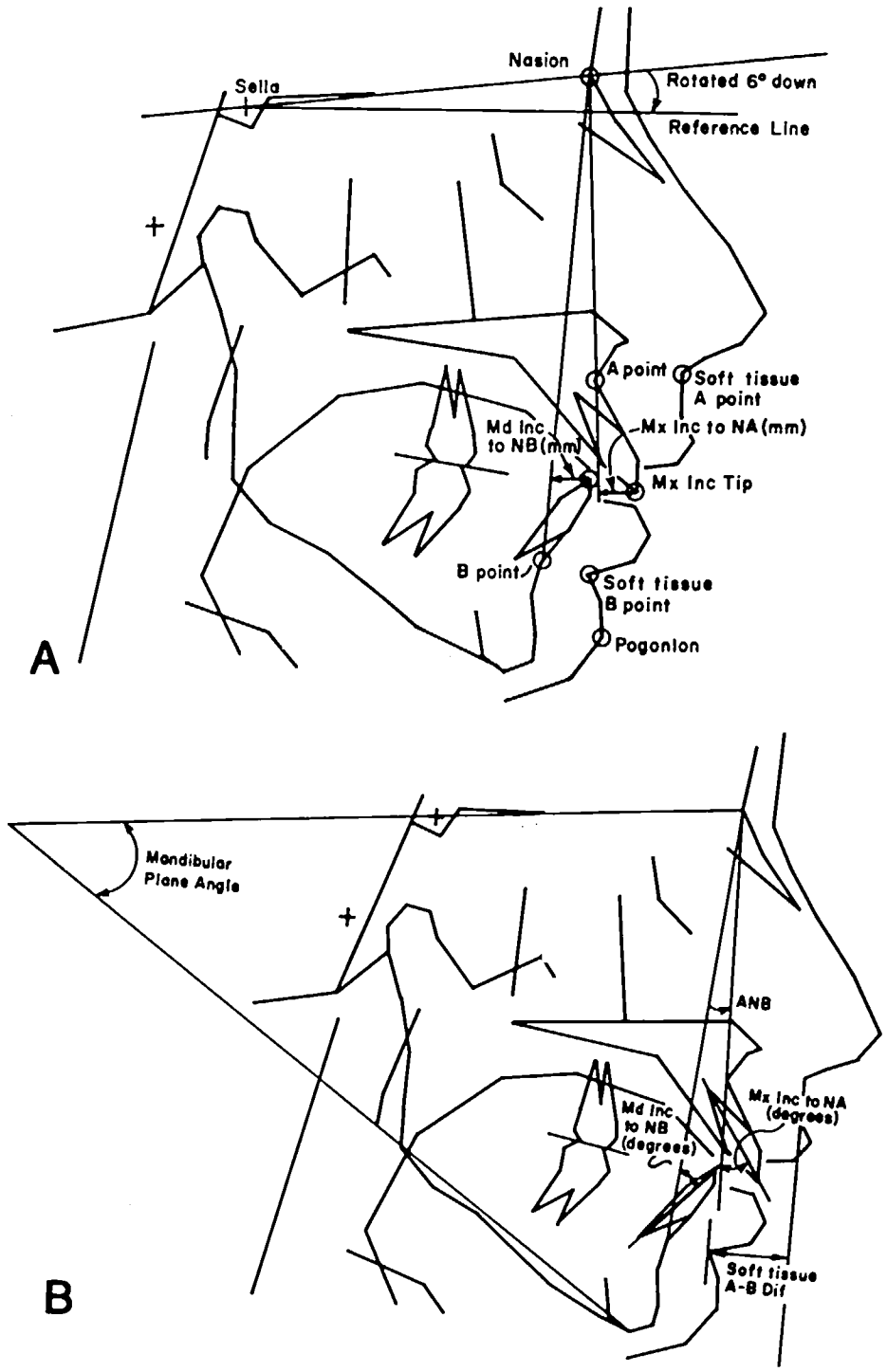

Fig. 1. A, Landmarks and millimeter measurements used in this study. Note the horizontal reference line, which approximates the true horizontal. **B,** Angular measurements.

Determination of treatment efficacy. For the dental-cast- and cephalometric data, two approaches were used to evaluate treatment efficacy: (1) Acceptable range achieved. If at the end of treatment the value of a measure fell within the normal range for that measure, an "acceptable" score was given; if not, the measure was "unacceptable." Our values for the normal range for important measurements are illustrated along with the percentage results in Table III. (2) Percentage goal

Table II. Changes in treatment

	Orthodontics only					Surgical-orthodontics				
	Pretreatment		Posttreatment			Pretreatment		Posttreatment		
	Mean	SD	Mean	SD	P value	Mean	SD	Mean	SD	P value
Horizontal position										
Point A	70.3	6.4	69.4	6.2	0.001	70.7	6.1	70.7	6.1	0.930
Point B	60.5	8.1	59.7	8.4	0.004	59.1	7.8	63.6	8.0	0.001
Soft tissue A	4.2	4.5	2.5	2.8	0.001	3.7	4.4	3.4	3.3	0.040
Soft tissue B	−8.5	6.3	−10.5	9.0	0.050	−11.0	6.3	−5.2	6.1	0.001
Pogonion	61.1	9.9	59.7	8.4	0.090	61.0	9.4	65.1	9.4	0.001
Maxillary incisor	72.3	7.8	69.3	7.6	0.001	73.2	8.0	73.0	7.1	0.780
Mandibular incisor	67.3	7.3	66.8	7.4	0.340	65.4	7.1	70.1	6.8	0.001
Vertical position										
Point A	54.9	4.1	55.8	3.7	0.004	54.1	3.9	54.9	4.0	0.001
Point B	88.5	6.1	89.5	6.5	0.003	87.9	6.1	92.4	5.8	0.001
Pogonion	105.5	7.2	106.4	7.7	0.001	104.8	7.2	109.0	7.7	0.001
Maxillary incisor	76.5	4.8	76.5	4.8	0.530	76.8	5.0	77.5	5.3	0.004
Mandibular incisor	71.7	5.3	73.5	5.0	0.001	70.5	4.7	74.9	5.0	0.001
ANB angle	5.1	1.4	4.7	1.0	0.030	5.8	2.0	3.0	3.2	0.001
Mandibular plane angle	34.0	7.0	34.3	7.1	0.190	32.2	7.5	36.2	7.1	0.001
Overjet	6.6	2.9	3.7	0.9	0.001	9.0	2.4	3.0	0.6	0.001
Overbite	3.9	2.2	2.8	1.1	0.020	4.9	2.8	2.8	1.1	0.001
Buccal interdigitation (L)	3.3	2.2	1.2	1.5	0.001	4.9	2.8	0.7	1.3	0.001
Buccal interdigitation (R)	4.1	2.4	1.1	1.1	0.001	5.9	2.2	1.2	1.1	0.001
Mandibular molar width	31.9	3.2	31.8	2.9	0.750	34.3	3.5	32.0	3.3	0.004

Table III. Treatment efficacy (percent posttreatment values within acceptable range)

	Acceptable range	Orthodontics only % acceptable	Surgical orthodontics % acceptable	P value
ANB	1 to 5	52	81	0.004
Mandibular plane	27 to 37	42	30	0.22
Maxillary incisor				
Degrees	16 to 28	30	60	0.007
Millimeters	1 to 7	64	72	0.41
Mandibular incisor				
Degrees	19 to 31	48	58	0.39
Millimeters	1 to 7	73	90	0.04
Soft Tissue A-B Difference	−2 to 8	15	33	0.06
Overjet	1 to 4	74	95	0.06
Overbite	1 to 4	83	80	0.83
Maxillary alignment	0 to 2	52	75	0.12
Mandibular alignment	0 to 2	83	85	0.83
Buccal interdigitation (L)	−2 to 2	78	75	0.80
Buccal interdigitation (R)	−2 to 2	83	75	0.54
Crossbite	Absent	100	95	0.28

achieved. The actual change occurring in a measurement during treatment was expressed as a percentage of the change needed to give an ideal posttreatment value (the ideal values are included in Table IV). The closer this was to 100%, the more "successful" the treatment.

Determination of esthetic changes. Facial photographs were scored by a panel of judges, consisting of 13 orthodontists, 10 orthodontic residents, 7 maxillofacial surgeons, and 7 maxillofacial surgery residents. Frontal and profile slides for 13 surgical and 13 orthodontics-only patients were ran-

Table IV. Treatment efficacy (percentage of goal achieved)

	Ideal value	*Orthodontics only % goal achieved*	*Surgical orthodontics % goal achieved*	
		Median	*Median*	*P value*
ANB	3	19	56	0.007
Mand. plane	32	−1	−22	0.21
Max incisor				
Degrees	22	−24	61	0.004
Millimeters	4	−47	20	0.007
Mand. incisor				
Degrees	22	1	−3	0.67
Millimeters	4	4	15	0.49
Soft Tissue A-B Difference	4	7	50	0.001
Overjet	2	64	87	0.001
Overbite	2	58	66	0.11
Max alignment	0	79	79	0.80
Mand alignment	0	92	80	0.04
Buccal interdig. L	0	81	79	0.82
Buccal interdig. R	0	76	78	0.33

Negative median value (−) indicates that at least 50% of the cases were either overcorrected, i.e., treatment caused value to "overshoot" ideal, or posttreatment value was farther from ideal than initial.

domly selected from those patients whose records contained pretreatment and posttreatment frontal and profile slides. These slides were randomized for type of treatment and stage of treatment when the photographs were taken (i.e., initial or end of treatment). The frontal and profile slides were presented simultaneously to the judges, with dual projection; four pairs were replicated for assessment of intraobserver reliability. The judges were instructed to rate each face on a visual analog scale of 100 mm length, with "very unattractive face" and "very attractive face" as the bipolar endpoints. The scales were digitized, and the distance from the left anchor mark to the judge's mark was calculated for each face.

Statistical analyses. For the cephalometric and dental cast data, the Wilcoxon rank sum statistic was used to compare the treatment groups for the percentage of goal achieved measures; the chi-square test was used to compare groups for the acceptable range achieved measures; and an analysis of covariance with the initial measure value as the covariate was used to compare the final mean values of the treatment groups. Paired *t* tests were used to compare the initial and final values within each treatment group. The level of significance was set at 0.01 because of the number of comparisons performed.

The rating scores for the esthetic data were analyzed by a multivariate analysis of variance with the stage of treatment as the within subject factor and group of judges, and the type of treatment as between subject factors. Treatment changes and differences between treatment groups are presented in graphs.

RESULTS

1. Reliability

Cephalometric and dental cast data. The method error and reliability of cephalometric tracing and digitization in our laboratory ranges from 0.2 mm for the *y* coordinate of the maxillary incisor to 0.7 mm for the *y* coordinate of point A. To estimate the accuracy of dental cast measurements, a random subset of 10 casts was remeasured. The intraclass correlation was greater than 0.97 for all measurements. This technique, however, does not take into account the possible error involved in identifying landmarks on the casts; we believe such errors to be small.

Esthetic data. Of the 34 judges, 27 were consistent in their ranking and rating of esthetics. The other 7 had statistically significant differences ($p < 0.05$) between the replicate slides.

2. Treatment effects

A major difference in the treatment of the two groups was in the prevalence and pattern of premolar extraction. With orthodontic treatment, 92% had extractions, either of maxillary first premolars alone or maxillary and mandibular first premolars. With surgical treatment, 38% had extractions, often only in the mandibular arch.

Changes in dental cast and cephalometric measures produced by treatment are displayed in Table II. After treatment, all of the cephalometric and dental cast measurements except the vertical position of point A and the maxillary incisor and the overbite and buccal interdigitation were significantly different between the orthodontic and the surgical groups. Overjet and overbite were reduced in both groups, but the reduction was greater in the surgical group. The surgical patients started with greater overjet and overbite than the orthodontic patients. They ended with less overjet and similar

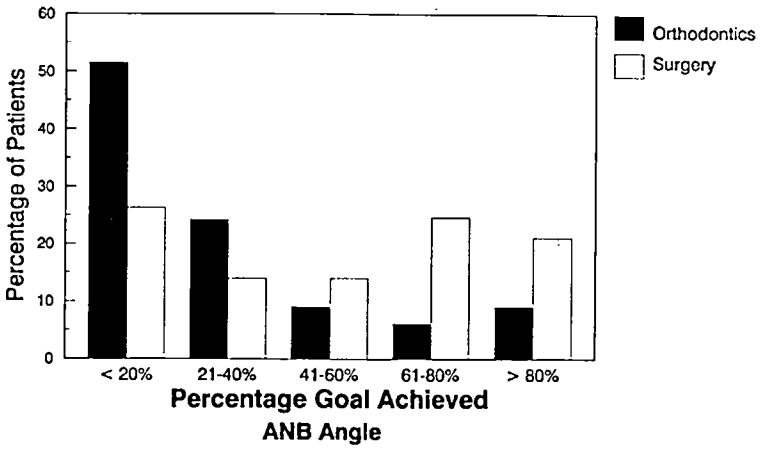

Fig. 2. Graphic representation of precentage goal-achieved data for ANB for the orthodontics-only and surgical-orthodontic treatment groups. Note that with orthodontic treatment alone, in half the patients, less than 20% of the goal was achieved. With surgical-orthodontic treatment, the average result was a higher percentage achieved, but even with surgery, one-fourth of the patients had less than 20% of the goal achieved.

overbite. Arch widths were not significantly changed by treatment in either group.

In the maxillary arch, with orthodontic treatment point A was retracted and moved inferiorly, just less than 1 mm in each direction. With surgical treatment, the average anteroposterior position of point A was unchanged, but it moved downward almost as much as with orthodontics alone. Similar but slightly greater changes occurred at soft tissue point A. The maxillary incisors were retracted nearly 3 mm in the orthodontic group, but were essentially unchanged in the surgical group.

In the mandibular arch, with orthodontic treatment point B also moved posteriorly and inferiorly, i.e., the skeletal Class II became slightly worse. The average change was less than 1 mm in the A-P plane of space and more than 1 mm vertically. With surgical treatment, point B moved forward and downward, nearly 4.5 mm in both directions on the average. For both groups, changes at soft tissue point B and pogonion were similar to those at point B. With orthodontic treatment, the lower incisor moved forward nearly 2 mm and down slightly, i.e., the mandibular dentition moved forward about 3 mm relative to the chin. With surgical treatment, the forward and downward movement of the lower incisor was similar to that of point B and pogonion, indicating that the relationship of the incisors to the chin was essentially unchanged. The mandibular plane angle increased more than 4° in the surgical group, but only 0.27° in the orthodontic group.

3. Treatment efficacy

Acceptable range achieved. For each dental cast and cephalometric measurement value, the percentage of patients in the orthodontic and surgical groups whose measurements were brought into the acceptable range is shown in Table III. Note that the majority of patients in both the orthodontic and surgical groups had acceptable overjet, buccal interdigitation, and overbite after treatment. The only marginally significant difference in dental characteristics was greater reduction of overjet with surgery (95% acceptable in the surgery group, 74% in the orthodontic group). The percent of patients with acceptable ANB angles after treatment was greater in the surgical group (81%) than in the orthodontic group (52%).

Percent goal achieved. Descriptive statistics for percent goal achieved are presented in Table IV. A significantly greater percentage of the "ideal" goal was achieved in the surgery group for ANB, the maxillary incisor location, the soft tissue A-B difference, and overjet. There was no difference for several other variables, primarily for mandibular incisor position and mandibular plane angle.

Figs. 2 to 4 illustrate the same data graphically for overjet, ANB, and buccal interdigitation. Note that for these important variables, some patients in both groups had excellent improvement and some had little improvement, but the percentage of the sample with improvement was greater with surgical treatment.

4. Esthetic changes

A multivariate analysis of variance showed that there were no significant differences between the oral surgeons and orthodontists in their rating of the surgical or orthodontic subjects either before or after treatment. Both before and after treatment, the mean esthetic rating for the orthodontic patients was higher than the mean

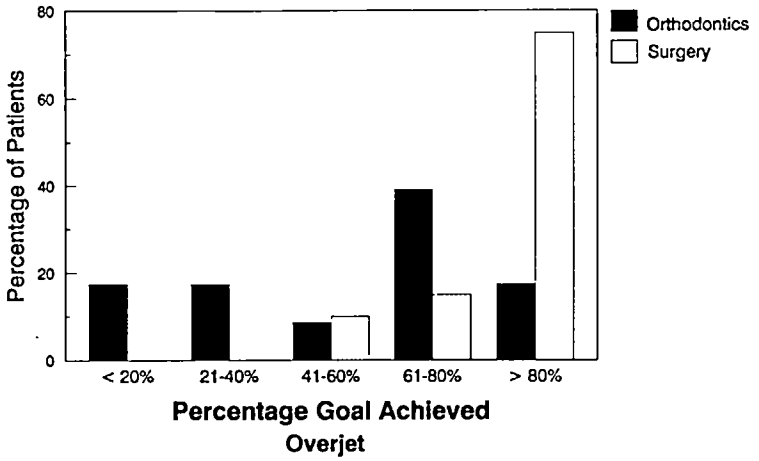

Fig. 3. Percentage goal-achieved data for overjet. For this criterion, surgical treatment was more effective.

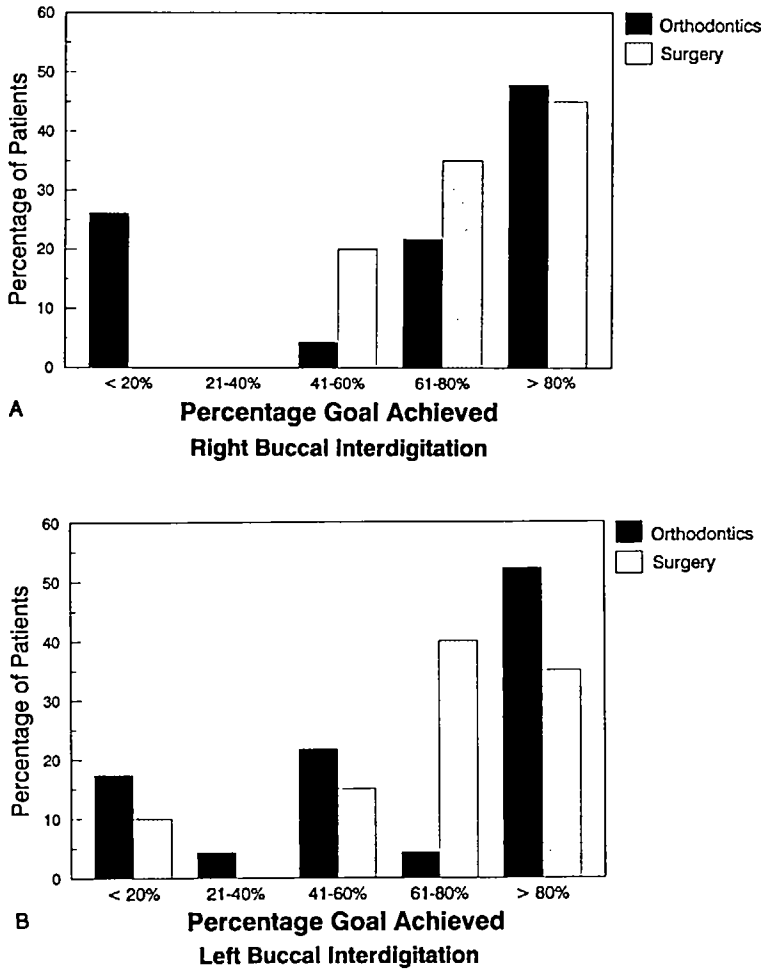

Fig. 4. Percentage-goal achieved data for **(A)** right and **(B)** left buccal interdigitation. Surgical and orthodontic treatment were about equally effective in correcting the buccal occlusal relationships.

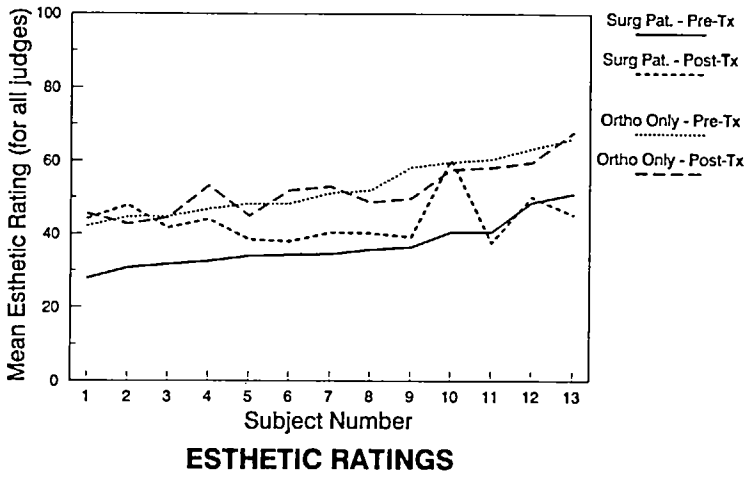

Fig. 5. Esthetic ratings before and after treatment. Note that the esthetic ratings for the orthodontics-only patients were higher than those for the surgerical patients before treatment. Surgical-orthodontic treatment produced an improvement in the esthetic rating for most of the patients, particularly those with the lowest ratings initially; orthodontic treatment had little effect.

rating for the surgical patients ($p < 0.001$). The esthetic ratings for the individual surgical and orthodontic patients (mean rating for all judges) are shown in a graph in Fig. 5. Within each group, the patients are arranged in order of increasing esthetic ratings, i.e., the least attractive patient in each group is subject 1, and the most attractive is subject 13. Note that esthetic changes from orthodontic treatment were small and were as likely to be negative as positive. Within the surgical group, improvements in the esthetic rating were noted for 11 of the 13 patients, and the improvement was greatest in the patients with the lowest ratings initially.

DISCUSSION

These results illustrate the different effects of orthodontic and surgical treatment approaches to skeletal Class II problems in adults. Some caution is required in generalizing to all skeletal Class II patients: (1) The patients were selected by clinicians for their treatment, rather than being randomly assigned; and (2) over time, the number of patients receiving surgical treatment has increased, and the number receiving orthodontic camouflage has declined, as clinical standards have changed. To some extent, the two factors tend to balance each other. Clinicians now recommend surgical treatment for some patients who probably would have received camouflage orthodontics a decade ago, which increased the chances of finding cases of comparable severity in both groups although no attempt was made to match the two groups for severity of initial malocclusion or skeletal deformity.

Because the treatment approaches were so different, different treatment effects would be expected, and these were observed. With orthodontic camouflage, one would expect the upper incisors to be retracted and the lower incisors to be proclined. In the orthodontic treatment cases studied here, the clinician's objective in nearly every instance was to retract the upper incisors bodily and to minimize forward movement of the lower teeth; but in many patients the upper incisors tipped lingually more than they were bodily retracted, and overjet was corrected as much by forward movement of the lower incisors as by retraction of the upper incisors. Class II elastics were employed in most of the orthodontic patients. As a side effect of the elastics, a downward rotation of the anterior maxilla, upper and lower incisors, and chin would be expected, and this also was observed.

With surgical treatment, the focus was advancement of the mandible to correct the mandibular deficiency, not retraction of maxillary incisors to camouflage it. Mandibular advancement surgery alone is used for patients who have normal or short anterior face height initially. Long-face Class II patients receive a combination of superior repositioning of the maxilla and mandibular advancement, and so were not included in this sample. It therefore is not surprising that on the average, the chin was moved downward as much as forward in the surgical patients studied here.

These surgical patients all were treated before 1986, and all had conventional maxillomandibular fixation (MMF) rather than rigid internal fixation (RIF). With MMF, the elasticity of the stretched soft tissues pro-

duces an effect similar to that of Class II elastics during fixation. This probably explains the downward movement of upper incisors that occurred in the surgical patients. For many of the surgical patients, the lower incisors were retracted during the presurgical orthodontics, and this probably masked the forward movement of lower teeth that is known to occur during MMF.[12]

At the end of treatment, the surgical group differed from the orthodontic group in two major ways: the surgical patients had a more ideal skeletal relationship, with the mandible further forward and a more protrusive profile, and they had maxillary and mandibular incisors in more ideal positions relative to their respective bony bases. In both groups, the buccal interdigitation of the teeth and the overbite were nearly ideal, and although overjet was greater in the orthodontic group, it was within the normal range. Therefore, as expected, the orthodontic treatment corrected the occlusion by displacing the teeth to camouflage the skeletal discrepancy. The surgical patients experienced greater esthetic improvement than the orthodontic patients, but the result was to bring the surgical patients up to the level at which the orthodontic patients started treatment.

The important clinical questions would be whether the camouflage was successful in terms of being esthetically acceptable, and whether the greater improvement produced by surgery was worth the greater cost and risk of surgery. In that regard, the difference in the esthetic ratings of these patients before treatment is important. Although some of the orthodontics-only cases go back into the early 1970s, it is clear that the clinicians selected patients for orthodontic treatment who had reasonable facial esthetics, and that they were successful in correcting the occlusion without producing detrimental effects esthetically. The patients selected for surgical treatment had poorer facial esthetics initially. It therefore appears that the clinicians favored surgery for patients with low esthetic rankings before treatment, who might be handicapped by psychosocial discrimination related to their appearance. Better facial esthetics often are observed in patients with Class II, Division 2 malocclusion than Class II, Division 1, and it is not coincidence that 40% of the camouflage patients in this study had Class II, Division 2 malocclusion initially.

Long-term follow-up of the patients in this sample is not yet available. From other studies, it is known that there are relapse tendencies after both orthodontic and surgical treatment, which can be controlled by careful technique during treatment and by orthodontic retention. Relapse after orthodontic treatment is particularly probable when the lower incisors have been moved too far forward, and the data suggest that this may have occurred in many of the camouflage patients. A major factor in stability after mandibular advancement is patient selection: stability is enhanced by rotating the mandible at surgery so that the mandibular plane angle increases.[13] Our sample included no surgical patients with the "wrong way" rotation of the mandible that is associated with relapse. At this point, there are no data to suggest that with competent treatment, stability is a major difference between surgical and orthodontic patients.

The risks and costs of the two treatment approaches must be balanced against the benefits when a treatment decision is being made for an individual patient. The greatest risk of mandibular advancement surgery is decreased sensation in the lower lip after surgery. About 50% of patients who undergo mandibular ramus osteotomy report some decrease in sensation,[14] but almost never is this severe enough that the patient regrets having undergone the treatment.[15] The greatest risk of orthodontic camouflage is severe resorption of the maxillary incisor roots. Kaley et al.[16] have recently reported that the risk of severe resorption is 20 times greater than usual when the maxillary incisor roots are torqued against the lingual cortical plate, a movement that is particularly associated with maximum retraction of protruding incisors in patients with Class II malocclusions. There is no doubt that surgical-orthodontic treatment is considerably more costly than orthodontics alone, because of the surgical and hospitalization costs.

From the results of this study and our analysis of the other factors involved, we suggest that camouflage treatment is most effective in patients who have reasonably good facial esthetics initially. The data suggest that orthodontic treatment alone can be accomplished without detriment to facial esthetics in these patients. The more severe the mandibular deficiency and the greater the overjet (and the poorer the facial esthetics), the more likely it is that the patient would benefit enough from surgery to make it worthwhile. These suggestions should be interpreted with the potential biases inherent in such a retrospective observational study in mind. Although the outcome comparisons are likely confounded by the selection of treatment by clinician decision, it is highly unlikely that in the current clinical atmosphere a randomized clinical trial would be judged ethical. A comparison of the relative efficacy of these two treatment approaches will probably require the accumulation of information from observational studies such as this one.

We thank Debora Price for technical assistance.

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AAO MEETING CALENDAR

1993—Toronto, Canada, May 15 to 19, Metropolitan Toronto Convention Center
1994—Orlando, Fla., May 1 to 4, Orange County Convention and Civic Center
1995—San Francisco, Calif., May 7 to 10, Moscone Convention Center
(International Orthodontic Congress)
1996—Denver, Colo., May 12 to 16, Colorado Convention Center
1997—Philadelphia, Pa., May 3 to 7, Philadelphia Convention Center
1998—Dallas, Texas, May 16 to 20, Dallas Convention Center
1999—San Diego, Calif., May 15 to 19, San Diego Convention Center