

Treatment of Severe Malocclusions by Correlated Orthodontic-Surgical Procedures

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Although surgical repositioning of the mandible for correction of severe Class III malocclusion has been an accepted treatment for many years, there has been a tremendous interest in other surgical procedures for the correction of Class I and Class II malocclusions in the last decade. Many of the newer surgical techniques have recently been reviewed by Converse and Horowitz¹ who demonstrated the maxillary osteotomies and sliding alveolar segment procedures used in the new approaches.

As the horizons of surgical orthodontics have widened, it has also become apparent that neither surgery nor orthodontic tooth movement alone is sufficient for treatment of many patients. A combination of orthodontic tooth movement and surgical repositioning of jaws or jaw segments is required in a majority of the cases to obtain optimum results. Three major questions are raised by the expanded surgical-orthodontic approaches:

1. What are the indications for the combined approach?
2. What are the risks of adding surgical procedures to orthodontic tooth movement?
3. If both orthodontics and surgery are to be done, which should be done first and why?

All three of these questions are important, and practicing orthodontists should have a reasonable understanding of the answers to all three. The third question, relating to the interaction of

orthodontics and surgery, is of the most immediate concern to an orthodontist. Since this question is the one the least well-treated in previous papers, it will be the primary focus of this discussion.

Indications for Surgical-Orthodontic Treatment

The primary indication for a combined surgical-orthodontic procedure is the presence of severe malocclusion in an adult, whether it be largely a skeletal problem or whether the problem is primarily of dental origin. No longer are surgical procedures confined to jaw repositioning. It is now both feasible and desirable to consider surgical repositioning of alveolar segments to correct tooth malpositions.

If surgery is a consideration, most orthodontists think first of procedures to move the mandible distally for correction of Class III malocclusions. These operations are still the most commonly performed of all the surgical approaches for correction of malocclusion. Technically, surgical approaches have been improved and broadened in recent years, particularly with the introduction of the sagittal-split technique for osteotomies in the ramus² (Fig. 1).

Occasionally the lower jaw can be moved back into an ideal relationship with the upper jaw and it will be found that the teeth fit almost perfectly. In this situation orthodontic tooth movement in addition to the surgical procedure is probably not needed. Two other factors need to be considered, however, before a decision is made as to whether some orthodontic tooth movement should be a part of the overall treatment plan.

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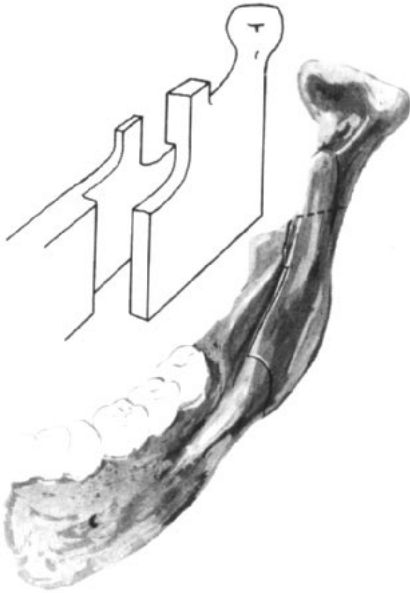


Fig. 1 The sagittal split procedure for mandibular osteotomy (Obwegeser technique).

The first consideration is a general one: Just as it is commonly understood that Class II malocclusion may be due to any combination of maxillary overgrowth and mandibular deficiency, so it is true that Class III malocclusion may be due to combinations of maxillary deficiency and mandibular overgrowth. It follows that not all Class III malocclusions should be treated by surgically moving the mandible posteriorly. Although the surgery is more difficult, it is quite possible to move maxillary alveolar segments anteriorly, or even to move much of the maxilla itself anteriorly, in surgical procedures to correct maxillary deficiency. Dramatic advances have been made in the past few years in this type of treatment for the Class III malocclusion associated with Crouzon's syndrome (mandibulofacial dysostosis) and other "Class III" malocclusions with severe midface deficiency.³ Most surgical procedures for Class III malocclusion will continue to be mandibular repositioning,

but this should not be thought of as the only surgical approach.

The second thing which must be considered in planning Class III correction is the effect of the jaw repositioning on the postoperative profile. After the lower jaw is moved distally, it may be that maximum tooth contact does not occur at the position which would allow the optimum profile result. This can be observed by comparing the repositioned casts with lateral cephalometric tracings.⁴ It may then be desirable to put the jaw in the ideal position and to move the teeth to conform to this position. This ideal jaw position may be slightly anterior or posterior to the position of maximum tooth contact. More frequently the difficulty will be in a vertical plane, and the ideal profile result will be obtained only by leaving a posterior open bite at surgery which will be corrected by tooth movement (Fig. 2). Profile is particularly likely to be a problem if posterior teeth have been lost. Bringing the alveolar ridges into ideal position for prosthetic restoration may cause a recessive chin position (Fig. 3).

Many Class III cases have a relatively narrow maxillary arch and would have to be put into unilateral posterior crossbite to obtain interdigitation. Although it does not affect the profile, this also is an indication for orthodontic expansion of the maxillary arch so that the jaws can be positioned symmetrically.

Surgical procedures for correction of Class II malocclusion have been much less common in the past than Class III correction. These procedures, however, are equally feasible and will become much more common in future years. As with the treatment of Class III malocclusion, the major decision must be between repositioning the maxilla distally or the mandible forward. If the cause of a severe Class II malocclu-

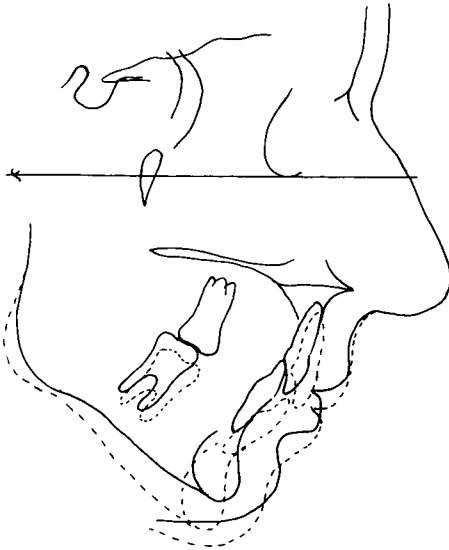


Fig. 2 In the surgical correction of this Class II, Division 2 malocclusion, the upper central incisors were surgically repositioned, and then the mandible was brought forward. Ideal profile required that the posterior teeth not be placed in occlusion. Instead, the interdigitation of posterior teeth was produced orthodontically after the surgical procedure.

sion is forward positioning or overgrowth of the maxilla, the best surgical procedure is to reduce the prominence of the maxillary alveolar segments. This is usually done by removing the maxillary premolars and sliding the anterior segments into the extraction site. A midline split between the central incisors may or may not be required, but this can be added to the surgical procedure without undue complications.

If the Class II problem is primarily one of mandibular deficiency, the better approach will be to bring the mandible forward. The sagittal-split technique for mandibular repositioning offers particular advantages for moving the mandible forward, since it provides excellent areas of bone contact after large forward repositioning of the mandible.

The deep overbite which is often associated with severe Class II mal-

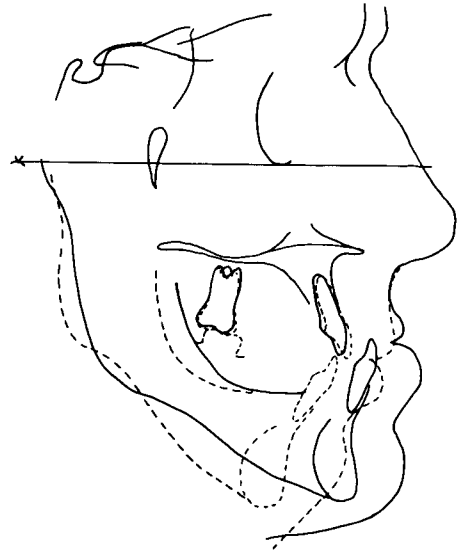


Fig. 3 Undesirable profile result with recessive chin following correction of Class III malocclusion, due to changes in vertical height after surgery. Cephalometric prediction can prevent this type of unexpected change.

occlusion may require orthodontic procedures to level the accentuated curve of Spee in the mandibular arch. Often this is so severe that no real surgical correction can be gained without orthodontic leveling. In addition to this change of vertical dimension, orthodontic tooth movement may be needed to adjust relative widths of the dental arches and to control individual tooth position. In some cases it may be necessary to retract flared mandibular incisor teeth prior to surgery (Fig. 4). Even more than for Class III malocclusions, orthodontic tooth movement in addition to the surgical procedure is likely to be a necessity in Class II treatment.

Surgical procedures can also be helpful in the management of severe Class I bimaxillary protrusion in adults. In the types of malocclusion discussed above, there is no alternative to the use of surgery to correct the skeletal deficiencies. Orthodontic treatment

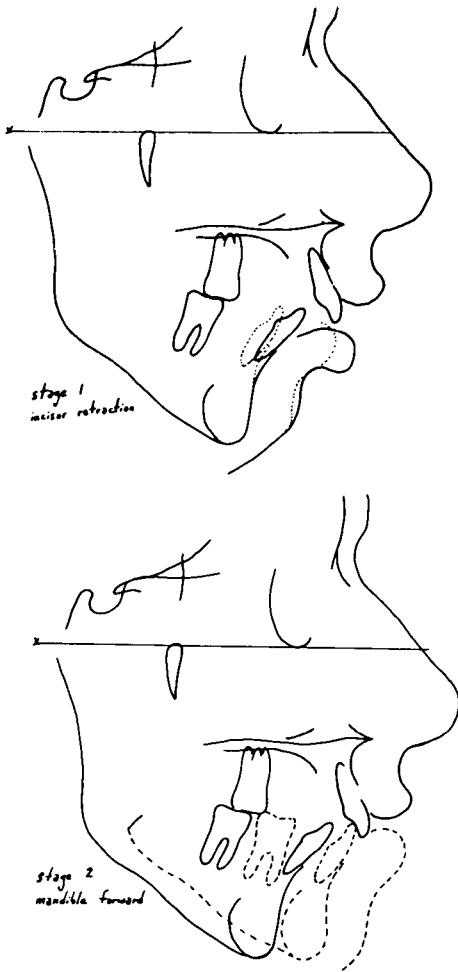


Fig. 4 The treatment plan for this severe Class II, Division 1 malocclusion calls for orthodontic retraction of flared mandibular incisors (after lower bicuspid extraction). Leveling of the lower arch will also be obtained prior to surgery. The mandible will then be surgically moved forward. Tracings are cephalometric predictions used in treatment planning.

alone is not possible. The correction of bimaxillary protrusion in adults, on the other hand, is feasible by orthodontic procedures alone. If maximum retraction of incisors is required, very careful control of posterior anchorage is necessary, and the orthodontic treatment becomes rather difficult. Such an adult

case would probably require between 18 and 24 months of effective use of a full-banded appliance. Surgical repositioning of the anterior alveolar segments, on the other hand, can be accomplished very quickly with absolutely no chance of posterior teeth moving forward into the extraction site created by removing the first premolars (Fig. 5). If orthodontic appliances are not required to complete the alignment of anterior teeth, total treatment time can be as little as eight weeks. Even if full-banded appliances are placed in order to obtain complete control of individual tooth position, treatment time should be six months or less. This dramatic reduction in total time and in the difficulty of the orthodontic treatment is quite appealing for many adults.

Surgical approaches can also be helpful in other types of Class I malocclusion, specifically with open bites and with lateral deviations of the jaws. Just as it is possible to move alveolar segments anteriorly and posteriorly, it is possible to surgically tip them medially or laterally to obtain better occlusion. It is also possible to extrude or intrude whole segments of the alveolar processes with a surgical approach. Vertical movement of extruded molar segments may be the only way to attack some open bites directly at their anatomical site of origin, since orthodontic intrusion of molar teeth is exceptionally difficult. Individuals who have severe lateral deviations of the jaws or who have exceptionally severe open-bite malocclusion are likely to have other skeletal malrelationships, so that it is difficult to describe a general treatment approach for these cases.

Risks of Surgical Orthodontics

The risks of surgical-orthodontic procedures may be discussed under four broad headings: (1) problems relating to lack of bony union at operative sites, loss of fragments, etc.; (2) devitaliza-

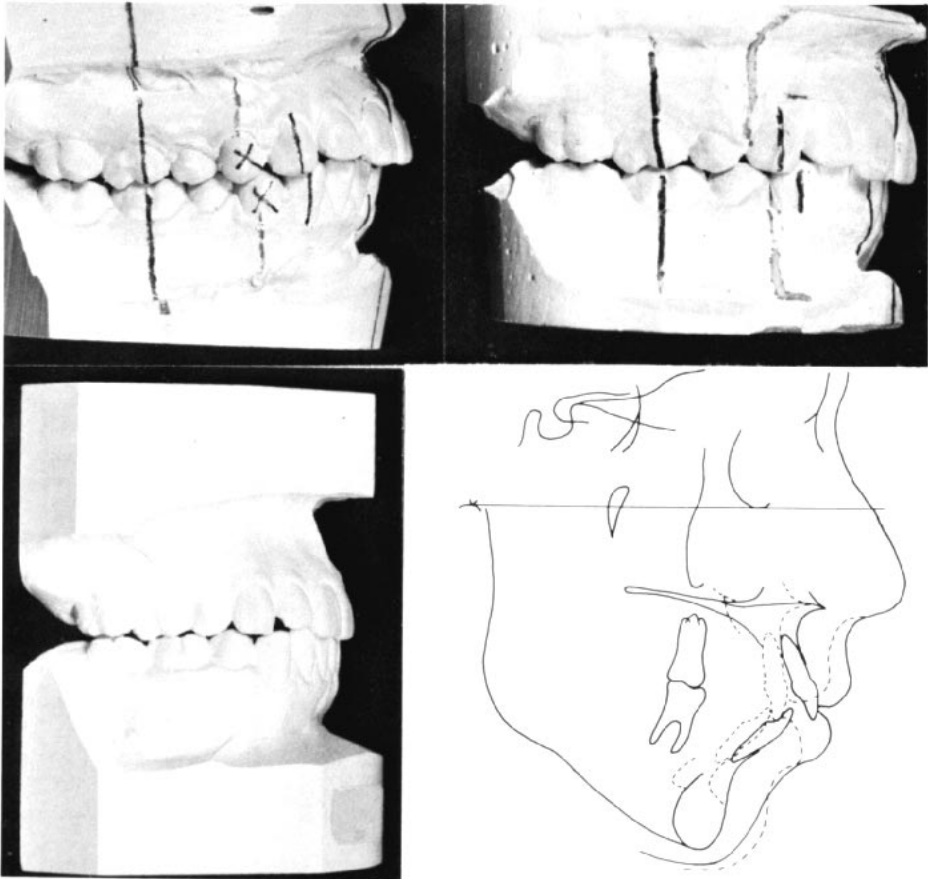


Fig. 5 Bilateral alveolar slide for correction of bimaxillary protrusion. A removable retainer was used for a few months after surgery. Orthodontic bands were not required, so arch bars were used for jaw fixation.

tion of teeth; (3) relapse after surgical procedures; (4) unanticipated esthetic results. All of these have turned out to be more frightening in prospect than in actuality. Although problems may arise with regard to any of these areas, experience has now shown that the risks of surgical procedures on the jaws are surprisingly low.

One of the greatest aids to modern surgical approaches is the improvement in anesthetic techniques which allows good control at the time of operation. With increased attention to surgical principles, excellent bone healing is obtained routinely. It is fortunate that

the vascular supply to the bones of the face and jaws is quite rich, for this means that loss of fragments due to an interruption in their blood supply does not occur. The same phenomenon is noted after automobile accidents or other severe trauma. Necrosis and sloughing of bone fragments is quite rare due to the exceptional blood supply.

It seems that there would be no way to cut through the alveolar bone beneath the roots of the teeth, thus temporarily interrupting the blood supply to the pulp, without causing devitalization of the teeth. This seems so

obvious, in fact, that it sometimes is hard for dentists to accept the now well-documented fact that devitalization of the teeth after such procedures occurs only rarely. In a series of fifty-six teeth being followed at the University of Kentucky after surgical procedures involving repositioning the alveolar segments, only eight do not respond to stimulation six to twelve months after surgery. Of these eight, only two show clinical signs of pulp necrosis—some of the others will not require endodontic therapy. Similar results have been obtained on other groups of patients at other institutions.⁵ Only if the cut through the alveolar process passes across the root of the tooth itself, can devitalization be confidently predicted. The risk of devitalization of the teeth is not one which can be ignored, but there is no need to plan endodontic procedures as an integral part of the overall treatment approach. This in all probability will not be necessary.

Relapse after surgical-orthodontic treatment depends, as does relapse after orthodontic treatment in general, on the extent to which the original causes of the malocclusion are still operating. It is not wise to operate to correct severe Class II or Class III malocclusions in individuals who are still growing. Since individuals with Class III malocclusions tend to have a prolonged period of mandibular growth, relapse is rather likely to occur if surgical procedures are carried out too soon. Numerous efforts have been made to establish ways of correcting skeletal Class III malocclusion surgically during the early teens, but these efforts continue to meet with a high rate of relapse. It can be very helpful to have orthodontic appliances on the teeth after surgery in cases of this type. Nevertheless, if the operation has been done too soon, relapse beyond the limit of orthodontic compensation is likely.

Orthodontists would predict that many corrections of anterior open bites by surgical means would relapse because of the continued activity of the tongue. Surgical open-bite correction by maxillary posterior osteotomy (depressing molar segments) has a less favorable prognosis than anterior osteotomy, but many of these cases remain stable. Perhaps the prolonged period of jaw fixation after surgery is a good means of "retraining the tongue." The same is true for the correction of bi-maxillary protrusions where the teeth are retracted the full width of an extraction space. Tongue pressure does not seem to lead to relapses, perhaps because of the adaptation which occurs during the several weeks after surgery when the jaws are wired together.

A final risk of surgery is that of producing an undesirable profile result which can happen if vertical dimension is markedly altered (Fig. 3). Particularly, the proportional relationship between anterior vertical height and posterior vertical height must be controlled during the planning stages. On some occasions it may be necessary to deliberately position the jaws after surgery so that posterior teeth are not in contact, and then to gently extrude the teeth to the new vertical position by orthodontic forces (Fig. 2). If this possibility is overlooked in treatment planning, and if careful cephalometric prediction is not done, unexpected changes in vertical dimension may compromise treatment results.

Which First, Orthodontics or Surgery?

It is probably safe to say that in the past when tooth positions made surgical jaw repositioning difficult or impossible, orthodontics was done before surgery. The major reason for this was the surgeon's need to have interdigitation of the teeth to stabilize the jaws after surgery. The disadvantage of this approach was that the orthodontist was often working

blindly. The only way he could tell whether progress was being made toward the desired tooth positions was to take impressions and compare relationships of the casts. Still, if the teeth were positioned poorly enough, there was and is no real alternative to a period of orthodontic treatment prior to surgery.

In many if not all correlated orthodontic-surgical procedures it is desirable to obtain final orthodontic positioning of the teeth after surgery. If the orthodontist is working blindly, relying only on cast relationships for guidance, it is almost impossible to obtain precision in the placement of teeth prior to surgery. Even if relapse tendencies are small, there is likely to be a small amount of change in jaw or segment positions after surgery. This can be compensated by slight tooth movement.

It therefore appears that a certain amount of orthodontic tooth movement prior to surgery will be needed in less than half the cases, with major tooth movement being required in a few. Orthodontic tooth movement after completion of the surgical procedure, on the other hand, is desirable in nearly all cases.

This reasoning, and our experience with the treatment of correlated orthodontic-surgical cases, has led us to a technique which calls for placement of orthodontic appliances on most of our cases prior to surgery. With the orthodontic appliance in place, we complete only the essential tooth movement to make the surgical procedures possible. The orthodontic bands with a rectangular stabilizing wire are then used for stabilization after surgery, and tooth movement is completed after initial healing has occurred.

For success, this approach depends upon careful planning of the treatment prior to surgery, involving both the orthodontist and the oral surgeon. Cephalometric films are used as a guide

for the final position of the jaws. Casts of the teeth are mounted on an articulator and placed as they are to be after surgery. A thin plastic interocclusal wafer or splint is made to relate the casts in this position. With the use of the wafer it no longer matters whether the teeth interdigitate well in the new jaw position at the time of surgery. The jaws can be firmly held with the teeth positioned into the wafer, and in the operating room there is no question as to exactly where the jaws should be placed. The use of the wafer also allows excellent control of the vertical dimension making it feasible to leave the bite somewhat open anteriorly or posteriorly if the case requires this.

In a typical Class III case requiring orthodontic tooth movement to expand the width of the maxillary buccal segments, we band the teeth prior to surgery and place heavy rectangular archwires contoured to the existing tooth positions. No tooth movement is attempted prior to surgery. An interocclusal wafer is made to stabilize the jaws in the preselected position, and rectangular archwires are used to provide hooks for intermaxillary fixation for approximately six weeks after surgery. At the time of release of the intermaxillary fixation, the stabilizing archwires are replaced by light multiloop archwires incorporating the desired expansion, rotations, and other tooth movements. Light vertical elastics are continued with these wires. The new jaw position is maintained while tooth movement is occurring, and heavy occlusal interferences are avoided. If necessary, other round or rectangular archwires are used to complete tooth positioning. Class III elastics are used if needed.

A similar treatment approach can be quite helpful in the correction of Class II malocclusions with a deep overbite where reduction of the severe curve of Spee is necessary (Figs. 6, 7, 8). In a

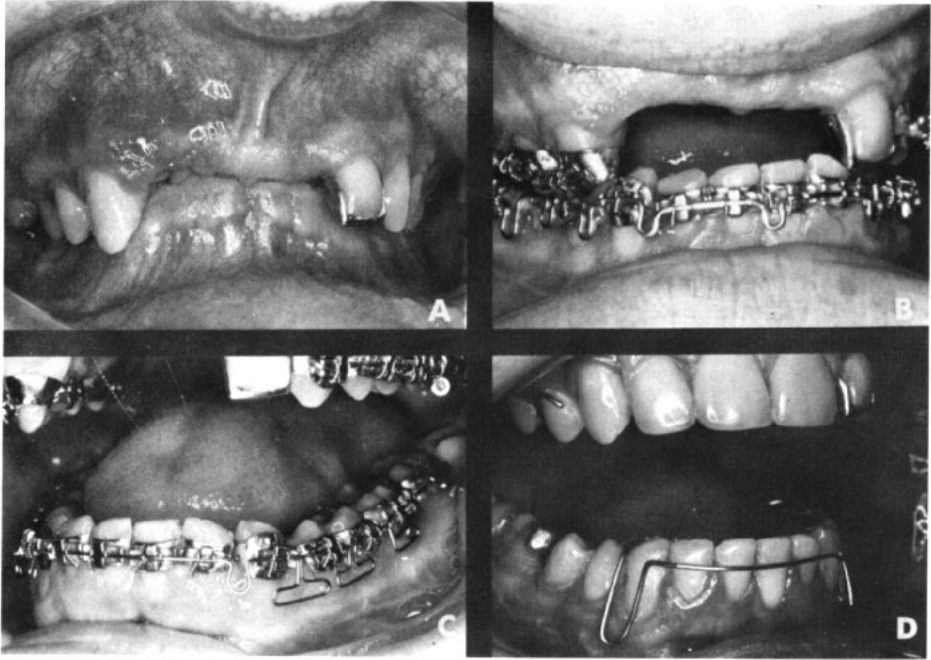


Fig. 6 Surgical-orthodontic correction of severe Class II, Division 1 malocclusion. A. The maxillary central incisors and the right lateral incisor had been lost. The overbite was so great that the mandibular incisors were hidden behind the maxillary alveolar ridge. B. Stabilizing arches in place, six weeks after surgery to reposition the mandible down and forward. The small loops in this wire serve as hooks for wire or elastic intermaxillary fixation. C. Multiloop wire used for levelling the mandibular arch after removal of the stabilizing wire. D. Intraoral view with retainers in place, eight months after surgery.

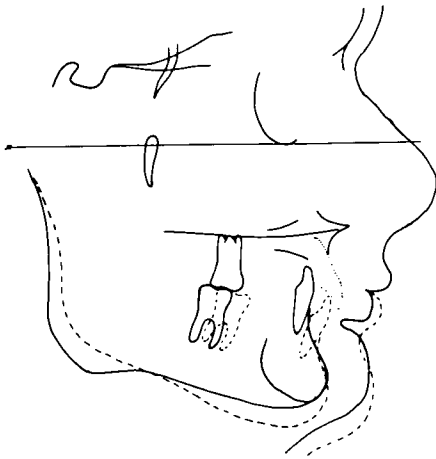


Fig. 7 Cephalometric tracings of the patient shown in Figures 6 and 8. The missing maxillary central incisor is shown in approximately its original position.

case of this type, after using the orthodontic appliance and interocclusal wafers for stabilization, leveling can be obtained with light loop archwires and vertical elastics during the period immediately following release of jaw fixation. Leveling at this time is much easier than it would have been prior to surgery when the occlusion was tending to maintain the tooth positions associated with the old jaw position.

Where alignment of the teeth is good, reduction of bimaxillary protrusion can often be done without using fixed orthodontic appliances at all. In such a case (Fig. 5), arch bars are wired to the teeth for stabilization of the segments, and removable orthodontic appliances or retainers are used after surgery. The removable appliances should be de-

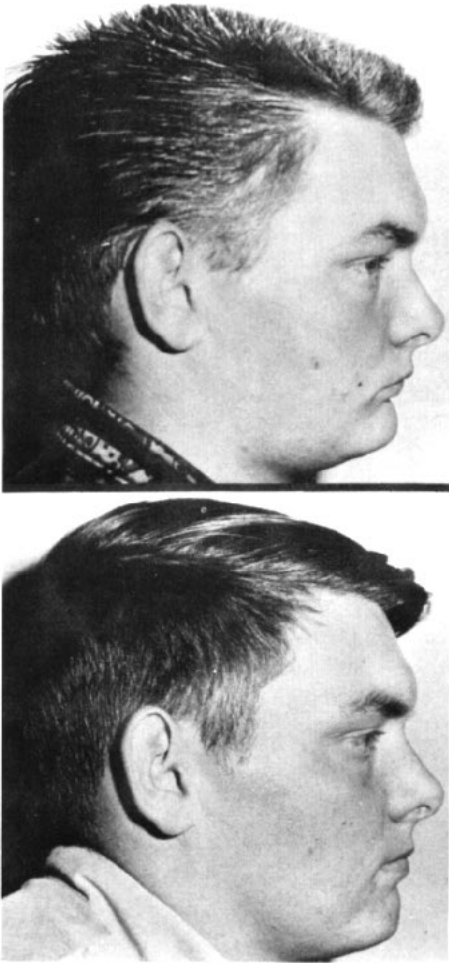


Fig. 8 Profile changes with surgical repositioning of the mandible (same case as Figure 6).

signed to produce the last millimeter of closure of the extraction site if this was not accomplished at surgery. In all cases the appliance should hold the extraction site closed. The maxillary retainer should also incorporate a bite plane to maintain anterior vertical dimension if the segments were intruded. Retention principles, in other words, are the same as with conventional orthodontic treatment except that there is little reason to worry about individual tooth movements.

SUMMARY

Surgical procedures for repositioning the mandible, maxilla, or segments of the alveolar processes of either jaw have become much more effective in recent years. This has opened a wide range of new possibilities for correlated orthodontic-surgical treatment of severe malocclusion in adults. For most such patients some orthodontic tooth movement in addition to the surgical procedures is required if an excellent result is to be obtained. A careful cephalometric evaluation of the problem and a cephalometric prediction of the results is a necessity in treatment planning. Close cooperation between oral surgeon and orthodontist in treatment planning is essential.

It is easier and usually better to do as much orthodontic tooth movement as possible after surgery, rather than attempting to do this before surgery. As a general approach, the orthodontic appliances should be placed prior to the surgical procedures, and the minimum amount of tooth movement necessary to make the jaw or alveolar segment movements possible should be completed. At that stage a plastic interocclusal wafer should be constructed to stabilize the repositioned jaw segments in the proper anteroposterior and vertical relationships. Heavy edgewise arches wired together provide excellent intermaxillary fixation. After surgery the stabilizing arches can be removed and working orthodontic wires can be employed to obtain details of tooth positioning. If individual tooth movements are not needed, arch bars can be used for surgical stabilization, but orthodontic retainers will still be helpful.

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