

Surgical Orthodontics: Maxillary Procedures

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The history of orthodontics can be seen as a process of first defining the limitations and then finding ways to overcome them. The use of cephalometric films to measure growth and treatment changes made it clear that nearly all of the changes accomplished by orthodontic appliances were limited to the teeth and alveolar process.¹ The concept of the unchangeable nature of basal bone came to the fore and the limits of the field of action appeared to be narrowly defined. It was as though we had discovered the size of the box that limited our sphere of influence.

A major breakthrough from this box occurred when the concept of orthopedic force came upon the scene.² The evidence that basal bone in the maxillary arch could be widened and changed in its anteroposterior position was definitely news that the box was larger. The number of papers and presentations dealing with these changes attests to our eagerness to find this sort of information.

Yet it was not until a working relationship developed with the oral surgeon that the lid was really taken off the box. Analyses of cases had shown that the discrepancy was often in the jaw size and shape, not just the teeth. Instead of being limited to moving the teeth within the alveolar process, we could employ surgical procedures moving all or part of the jaw structures, correcting the actual problem rather than working around it.

It is significant that both of these ideas came from outside the United States. Palatal expansion techniques had long been used in Europe, but very

little interest was shown by orthodontists in this country. It was only when Haas and others at Illinois started their investigations that attention was paid to a technique that had been accepted elsewhere.

Segmental osteotomies, especially in the maxilla, were used and documented in Europe starting in the '50's, but surgical procedures here were generally limited to prognathic reduction. Now there is sufficient documentation to know that mandibular lengthening,^{3,4} maxillary reduction and shortening,⁵ and modification of anterior mandibular form⁶ are possible. Case records are showing which procedures are stable, and the anatomic and functional situations that help or hinder the stabilization process.

Orthodontists must be aware of the variety of surgical procedures that are possible and something of the relative difficulty and stability of each, and the surgeon must know the limits and possibility of orthodontic tooth movement. Both must aim toward the best occlusal and facial results that are possible for the patient. It is this working together of two disciplines, which are very different in their orientation, that produces a balanced totality in treatment approach. The surgeon will tend to be more aggressive and innovative in approach, while the orthodontist will generally be more cautious in proceeding and concerned about long-term results. At the same time the new ideas of the surgeon are what can aid the orthodontist in breaking out of his own box and seeing new possibilities of treatment. This kind of communication results more in mutual illumination rather than in compromise. The term compromise carries with it the implication of something less than the best,

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some midway point that is short of the desired goal. The type of result that is possible with the right kind of surgical orthodontic treatment is not compromise, but rather an approach to the best result in function and appearance.

To recognize this is to greatly expand the definition of comprehensive orthodontic treatment. It also removes many of the comfortable boundaries in treatment planning and diagnosis, and requires a whole new look at cephalometric norms. It matters a great deal whether it is a deficient mandible or a protrusive maxilla if either one can be changed.

Certainly there is the other side of this picture to be considered. There is a risk factor in any surgical procedure, especially when a general anesthetic is employed. Disastrous reactions to anesthetics or blood transfusion do occur. Some procedures are difficult to stabilize and loss of vitality in teeth or bony segments has been reported if the blood supply is lost following surgery.

The patient's psychological adjustment to the dentofacial alteration can be very difficult and may require considerable supportive counseling in the first weeks after the operation. Unrealistic expectations and unfavorable comments from other people can bring on severe emotional depression that may be difficult to overcome. In addition, the problems of the finances involved in surgical-orthodontics and hospital care are formidable and may rule out such treatment altogether in some situations.

Within the field of surgical orthodontics more extensive use of partial and complete maxillary surgery has been the most recent breakthrough of limitations. Maxillary procedures make possible extensive changes in the anteroposterior as well as the vertical position of the teeth and jaws. The procedures to be considered here are:

1. Anterior maxillary osteotomy. Usually the six upper anterior teeth are involved in the segment to be moved. The segment may be moved posteriorly and/or vertically.

2. Posterior maxillary osteotomies. Elevating and possibly widening the maxillary posterior teeth are the primary movements. This procedure may be used in combination with anterior osteotomy.

3. Total maxillary osteotomy. Advancement and/or elevation of the entire maxillary dentition can be accomplished.

Anterior Maxillary Osteotomy

This procedure is the most common type of maxillary surgery. At the University of California at San Francisco, over 100 patients have undergone this procedure starting in 1969. A detailed cephalometric analysis of the immediate and follow-up treatment results on 19 of those patients has been completed and will be presented elsewhere. Profit and White reported their experience in 25 cases in 1973⁵ and presented diagnostic criteria and a comprehensive discussion of the factors involved in patients when this surgery is employed. Other significant reports have been made by Kent and Hinds,⁷ and Bell and Dann⁸ who reported on 46 patients.

From these and our own experience the following conditions would suggest that anterior maxillary osteotomy may be indicated:

1. Marked protrusion of the maxillary teeth with fairly normal incisor axial inclination in a nongrowing patient.

2. Excessive vertical height of maxillary incisors with a deep incisor overbite and too much upper incisor and gingival tissue displayed when smiling.

3. General health and dental condition of patient good with few missing permanent teeth.

4. Profile appearance would benefit by reducing prominence of the upper lip relative to the nose and lower face.

5. Retraction of teeth is needed but cannot be done with conventional orthodontic appliances because of lack of patient cooperation.

6. Orthodontic movement of teeth is impossible or too risky because of pathological root conditions such as ankylosis or resorption.

7. Movement of from one to eight teeth is necessary.

Expected results with this surgical procedure:

1. Retraction of the maxillary teeth can be reliably achieved. The amount of retraction is usually the width of the first bicuspids, which are removed at the time of surgery.

2. Control of vertical movements of the segment with either intrusion or extrusion possible.

3. Change in axial inclination of the incisors or bodily movement can be produced.

4. The upper lip and subnasal area generally equal the reduction in prominence of the upper teeth and alveolar process.

5. The correction is very stable and shows minimal relapse tendency.

6. Undesirable side effects to teeth such as loss of vitality or root support in the operated segment are rare and usually the result of faulty technique.

7. Healing is generally uneventful and surprisingly pain free; management is easy because intermaxillary fixation is rarely needed.

8. Reduction of lip prominence while maintaining the same nasolabial angle, as a result of retracting nasal base and sometimes nasal tip.

Preliminary Orthodontics

The procedures recommended with anterior maxillary osteotomy are as follows:

1. Place a complete maxillary edge-wise appliance including facebow tubes (.045) on molars. Usually a complete mandibular appliance is also necessary.

2. Establish desired posterior interdigitation and width as determined by treatment plan. The usual goal is to achieve tooth-to-tooth contact around the arch at surgery.

3. Level and align mandibular teeth as needed and complete all planned space closure.

4. Align maxillary anteriors, coordinate cuspid width with lower arch and with maxillary posterior teeth. If first bicuspid extraction is anticipated, these may be left unbanded but preferably not extracted prior to surgery. The vertical level of the cuspids should be adjusted to coordinate with projected vertical and rotational movement of the anterior segment.

5. Full size rectangular arches (.021 x .025 or .017 x .025) should be placed and tied back.

Ready for Surgery

6. Four weeks prior to surgery obtain complete presurgical records including: a) two sets of models, one set for permanent record, trimmed to centric relation; b) lateral headfilms; c) intra-oral photos; d) face photos; and e) periapical films of surgery site area.

7. Trial surgery is performed on one set of models. Registration marks on models should show dimension of tissue to be removed. The anterior segment should be positioned to fit smoothly with posteriors with the best possible incisor angulation and no contact with lower anteriors.

8. If a surgical cut is to be made interdentially without extraction, adequate crown and root separation (2-3 mm) must be shown in X-rays.

9. Show projected hard and soft tissue changes on lateral headfilm tracing.

10. These records should be reviewed

by the surgical-orthodontic team two weeks prior to surgery. Any problems may require postponement of surgery.

11. A full maxillary rectangular archwire with tie backs is made to fit the trial surgery model (step 7). An auxiliary .045 round arch is also formed to fit in facebow tubes, and may be used to intrude or stabilize the segment.

12. A mandibular posterior occlusal coverage splint is made in case posterior bite opening is needed to prevent postoperative incisor contact.

Surgical Procedure

13. Patient is admitted to hospital. Records from steps 6, 7, and 9 must be present.

14. Referring orthodontist or designated substitute must be present in the O.R. to assist in determining segment position and to place archwires. Auxiliary .045 arch is generally placed and can aid in vertical control of segment.

15. Mandibular splint is placed if needed.

Postsurgical Treatment

16. Archwires and splint are left undisturbed for six weeks or as directed by surgeon.

17. Obtain lateral headfilm.

18. Complete needed leveling, root movement and space closure.

19. Normal finishing procedures and retention may be employed.

Some of the aspects enumerated above are illustrated in Cases one through four.

Posterior Maxillary Osteotomy

This procedure is represented by very few cases in our own experience, but success has been widely reported since Kole's report in 1959,⁹ and West and Epker in 1972.¹⁰ The indications for this procedure are:

1. Anterior open bite of 2 mm or more.

2. Excess lower facial vertical dimen-

sion, seen in both frontal and lateral views, with evidence of muscle strain needed to obtain lip closure.

3. Position of maxillary incisors is acceptable esthetically and would occlude with the lower incisors if the mandible were free to hinge farther closed.

4. Lateral headfilm shows evidence of excess vertical maxillary posterior development with the apices of the teeth some distance down from the palatal plane.

5. Mandible appears somewhat retracted as a result of being hinged open by posterior dental height.

Results to be expected with this procedure are:

1. Anterior open bite closed by allowing mandibular rotation.

2. Increased chin prominence and reduction of muscle strain upon lip closure.

3. Stability of correction.

Those procedures which differ significantly from the previous are:

1. Complete alignment and planned space closure in mandibular arch.

2. Align maxillary anterior teeth and correct axial inclination. If upper bicuspids must be extracted, do not fully close extraction spaces. Do not allow any extrusion of upper anterior teeth. Generally, an accentuated step in level between the anterior and posterior segments is necessary.

3. One set of models is mounted in hinge axis location on an articulator in centric relation. Trial surgery is performed on the upper model allowing the incisor open bite to close. There should be 2-3 mm of incisor overbite.

4. An auxiliary lingual archwire may be used to aid segment stability.

5. Intermaxillary fixation and archwires are left undisturbed for 6-8 weeks or as directed by the surgeon.

Case five illustrates this procedure.

Total Maxillary Osteotomy

This procedure is the most recent in terms of our experience, but there are many cases where it seems the treatment of choice. Pioneering description of such surgery can be found in 1935 by Wassmund,¹¹ but reliable and successful techniques were not developed until 1969 with the work of Obwegeser,¹² and Perko in 1972.¹³ Reports have been published in 1975 by Bell,¹⁴ by Hall and Roddy,¹⁵ and by Epker and Wolford.¹⁶ This last report includes cases in which advancements in the zygomatic as well as maxillary areas were performed. The changes possible when the entire maxillary alveolus is moved can be very dramatic.

The indications for this procedure may include all of those previously listed for posterior maxillary osteotomy but also including:

1. Excess vertical development of maxillary anterior teeth with an excessive display of upper teeth and gum tissue when smiling.
2. Closure of anterior open bite by mandibular advancement and rotation surgery would place the mandible in an unesthetic or unstable position.
3. Concavity of the midface as a result of maxillary retrusion.
4. Markedly asymmetric development secondary to severe mandibular asymmetry.

The expected results could include the same three listed for posterior osteotomy and, in addition:

1. Reduction in visibility of maxillary incisors and improved relationship to upper lip when the maxilla is elevated.
2. Increased fullness of midface when the maxillary structures are advanced resulting in profile improvement.
3. Improvement of symmetry in the

maxilla making correction of mandibular symmetry possible.

The preparation for this surgical procedure is similar in many ways to that described previously, except that the integrity of the dental arch is not broken at the time of surgery. The orthodontic treatment is similar to mandibular reduction by ramus osteotomy in that the surgical site does not go through the dental arch and, therefore, the arches may be aligned and ready for good interdigitation. There is no need for actual participation by the orthodontist in the operating room.

Cases six and seven illustrate this procedure.

CONCLUSION

The greatly increased use of maxillary surgery in the last five years has widened the possibilities for correction of dentofacial deformities. The best result in occlusion and esthetics in each situation is the goal that the orthodontist and oral surgeon must keep in mind: working together. While unfortunate side effects can occur, the experience of teams using well-managed orthognathic surgical methods shows a very good success record.

The indications and treatment procedures for anterior, posterior and total maxillary osteotomies were discussed. Some of the conditions which can be well-treated are maxillary protrusion and retrusion, anterior deep and open bites, lip imbalance due to dental protrusion or excess vertical dimension, and maxillary asymmetries.

The limitations of orthodontic practice without the inclusion of appropriate surgical procedures exclude real help for many of the people who need it most. We must be realistic in evaluating our achievements so that constant improvement is possible.

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Original Case #1

The lateral headfilm tracing of a male age 17 years, 3 months shows a maxillary dental protrusion with satisfactory mandibular form. Dental models show a Class II, Division 1 malocclusion with deep incisor overbite and 14 mm overjet. Facial appearance is good except for upper lip prominence and curling of the lower lip.

Orthodontist, Phillip Borges.

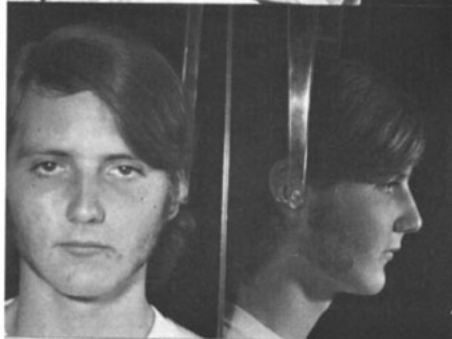
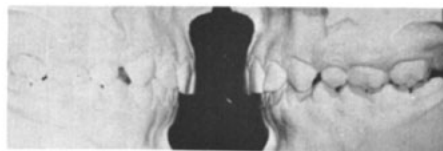
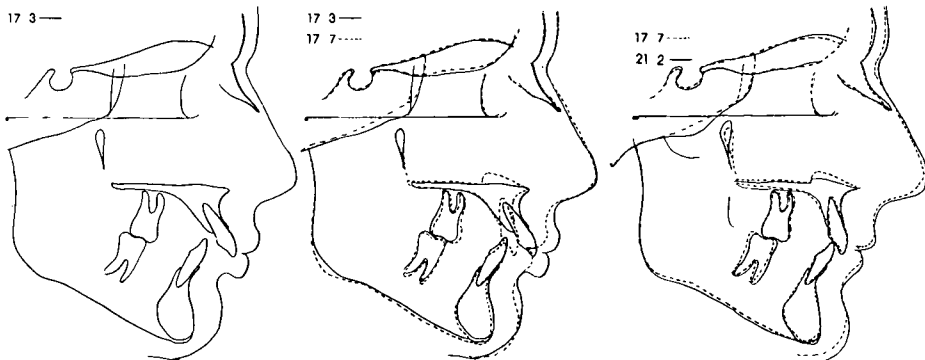
Anterior Maxillary Osteotomy

The superimposed tracings at age 17 years, 7 months show retraction of the upper incisal edge 9 mm and intrusion of 2 mm at apex. The models show improved occlusion with reduction of overbite and overjet but incomplete closure of surgical-extraction sites because of time limitations. Facial appearance soon after surgery shows lip retraction and an apparent increase in chin prominence.

Oral surgeons, William Ware and Bernard Levin.

Final

The superimposed tracings at age 21 years, 2 months show almost no dental or jaw change but some increased soft tissue chin and nose prominence. His face now shows maturing contours. The study of many cases for at least this long is needed to evaluate these procedures adequately.



Original Case #2

The lateral headfilm tracings of a female age 26 years, 5 months show a deep, closed incisor overbite and maxillary protrusion with good mandibular form. The models show a Class II, Division 1 malocclusion with a deep bite and 13 mm overjet. Her facial appearance was pleasing except for upper lip prominence and lower lip curl. Preliminary orthodontics involved headgear to establish a solid Class II molar relation.

Orthodontist, Don Guest.

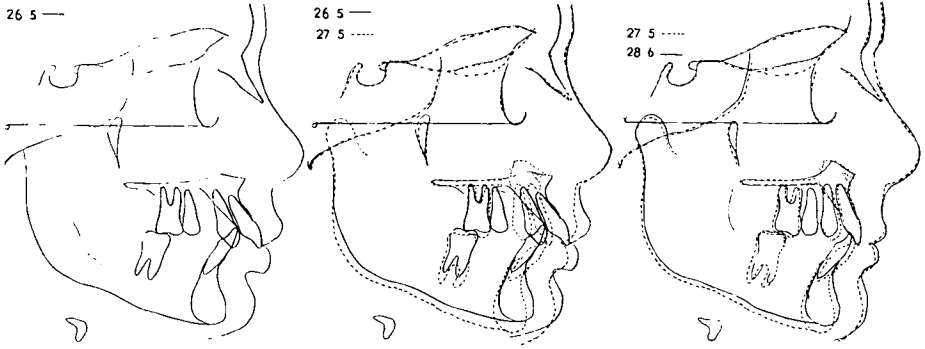
Anterior Maxillary Osteotomy

The superimposed tracings show 8 mm of incisor retraction, 5 mm of apical intrusion and 2 degree opening of the mandible (age 27 years, 5 months). The intraoral view three weeks post-surgery shows corrected incisor position. A .021 x .025 maxillary archwire is tied back, and an auxiliary .045 labial arch is used to aid in stabilizing and intruding the upper incisors.

Oral surgeons, Guy R. Courage and Richard Roman.

Final

The superimposed tracings at age 28 years, 6 months show stability of upper incisor correction and reclosure of the mandible to its original position. Intraoral views show satisfactory final occlusion with tight contacts and good interdigitation. Her final facial appearance is good.



Original Case #3

The lateral headfilm tracing shows moderate facial convexity (NAPo = 13 degrees) with protrusive lips and maxillary incisors for this female age 38 years, 5 months. Intraoral photos show a Class II, Division 1 malocclusion with 9 mm incisor overjet and a deep anterior overbite. The upper right and lower left first molars were missing. The facial photos show a difficult and strained lip closure.

Anterior Maxillary Osteotomy

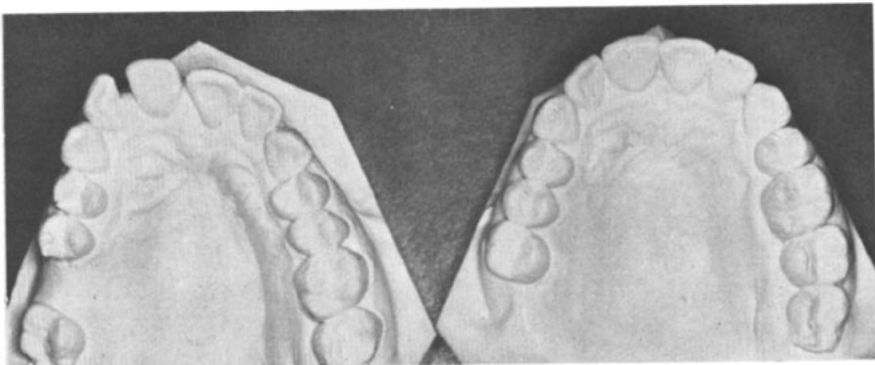
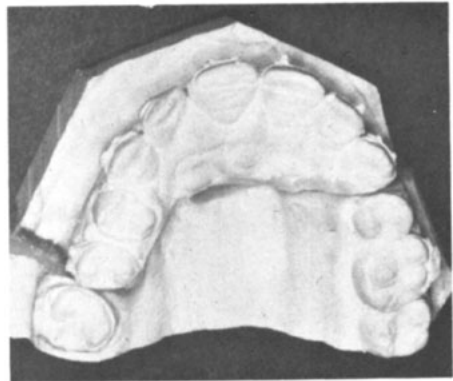
The upper right first molar space was used as an osteotomy site placing eight teeth in the anterior segments. The superimposed tracings at age 39 years, 2 months show 7 mm of maxillary retraction, a marked reduction in lip prominence, and some nasal tip retraction. Facial convexity was eliminated (NAPo = 0 degrees) and the mandible hinged open slightly. The surgical

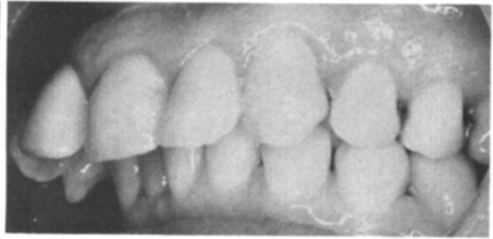
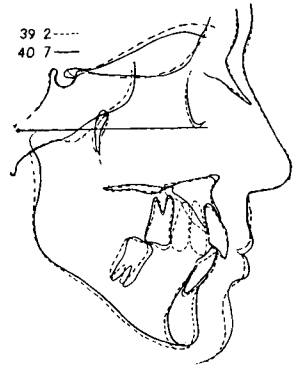
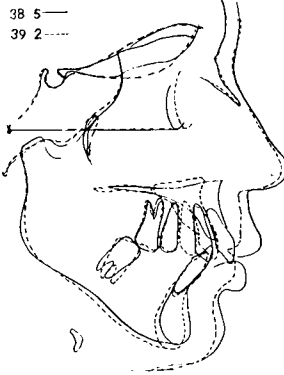
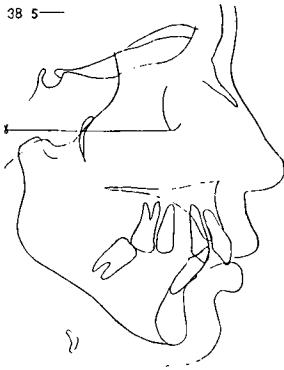
mock-up model demonstrates retraction of anterior teeth into the right first molar and left first bicuspid spaces.

Oral surgeon, William Ware.

Final

The superimposed tracings seventeen months later show no maxillary change and a return of the mandible to its original position. The final intraoral photos show satisfactory overbite and overjet relationship. Her facial photos show that relaxed lip closure was possible. The maxillary models before and after surgery demonstrate the change in arch form.





Original Case #4

The lateral headfilm tracing of a male age 37 years, 5 months shows an extreme deep closed bite with lower incisors closing into palatal tissue. This is also demonstrated in the lateral headfilm taken just prior to surgery. The intraoral view shows the malocclusion with spacing and prominence of upper incisors.

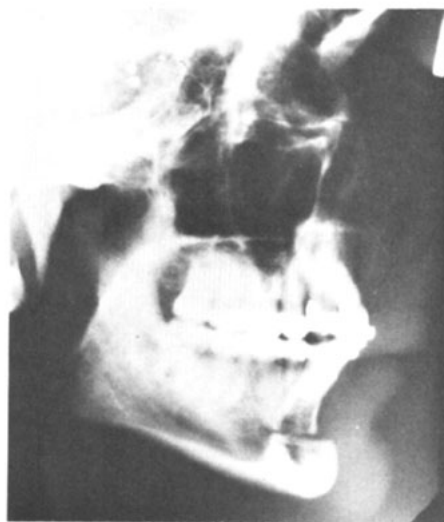
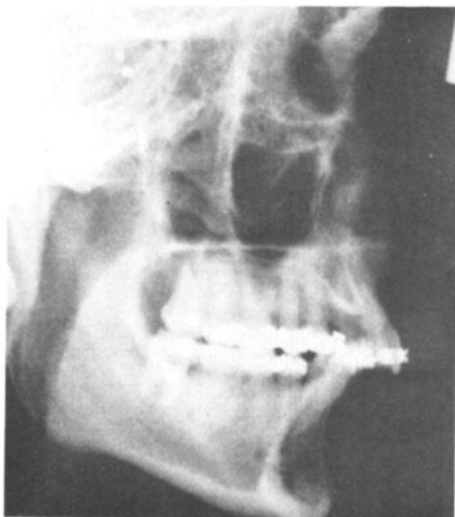
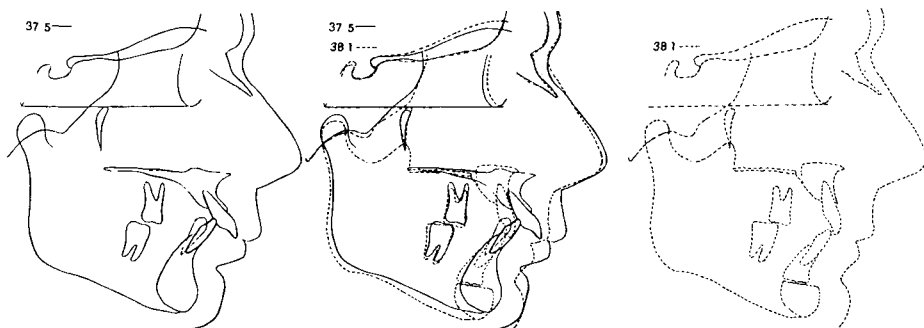
Anterior Maxillary and Mandibular Osteotomies

The mandibular osteotomy at age 38 years, 1 month was necessary to open the anterior overbite. Superimposed tracings show 10 mm surgical intrusion of lower anterior teeth, and in the maxilla 14 mm crown retraction with 5 mm apical intrusion of the incisors. The lateral headfilm shortly after surgery shows the osteotomy sites, and these can also be seen in the postsurgery headfilm tracing.

Oral surgeon, William Ware.

Final

The intraoral view shows the occlusion during the retention period. Long-term wear of a maxillary Hawley retainer with a bite plane was advised. The photo shows his facial appearance one year after surgery. Esthetic improvement was not a major concern of this patient.



Original Case #5

The lateral headfilm tracing shows the extreme facial height of this male age 30 years. The mandible is steep (MP to SN = 41 degrees) and posterior maxillary height is excessive, as shown by the distance of the molars from the palatal plane. The intraoral views show a malocclusion with 9 mm anterior open bite and moderate upper and lower crowding. His facial appearance reveals evidence of mentalis muscle strain for lip closure and further evidence of excessive facial height.

Orthodontists, Dennis McKee and William Eckhart

*Posterior Bilateral
Maxillary Osteotomies*

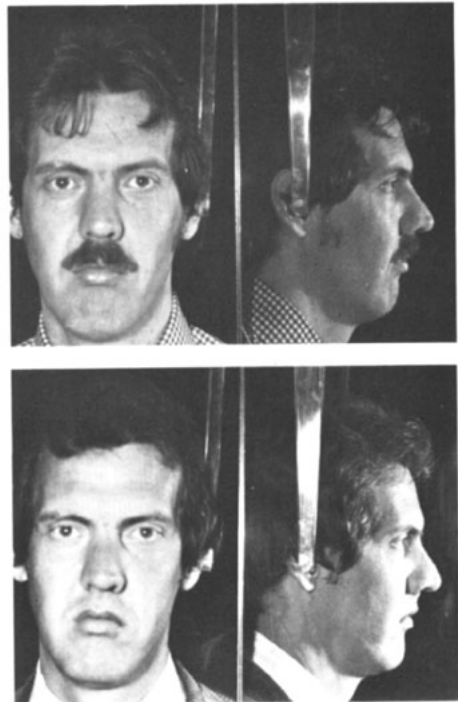
Superimposed tracings show 4 mm intrusion and anterior movement of maxillary posterior segments (age 31 years, 0 months). The mandible has

hinged closed 4 degrees increasing chin prominence. Normal anterior overbite was established. The models just prior to surgery show alignment of teeth but with anterior bite still open. On the surgical mock-up models the posterior segments are elevated. This must be done on an articulator in hinge axis relation to determine incisor relationship.

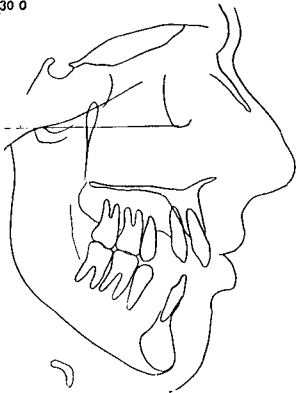
Oral surgeon, William Ware.

Final

Superimposed tracings at age 32 years, 5 months show minimal skeletal and dental changes. Lips show reduction of postsurgical swelling. The intraoral views show the occlusion with maintenance of good incisor overbite. Mandibular extraction spaces remain and should have been closed before surgery. His facial appearance shows relaxed lip closure.

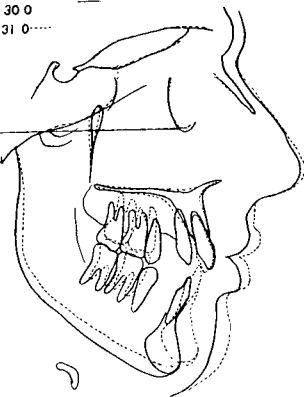


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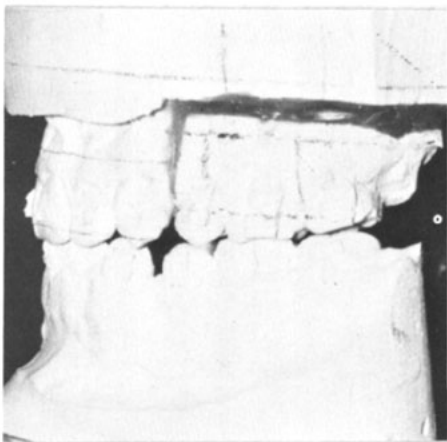
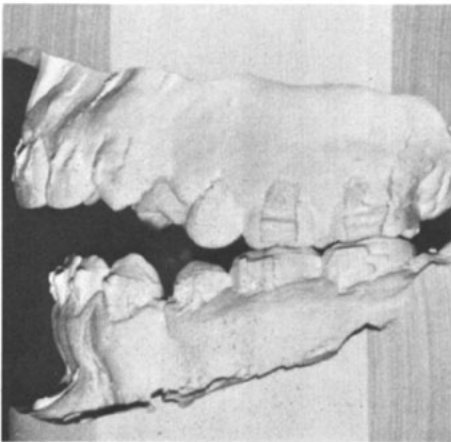
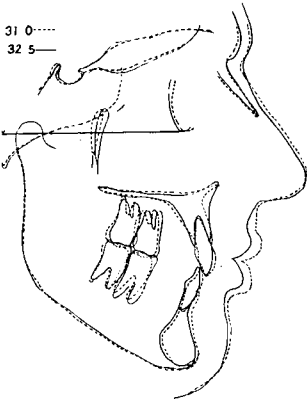
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Original Case #6

The lateral tracing shows a 13 mm anterior open bite for this male age 17 years, 5 months. The mandible is steep (MP to SN = 46 degrees) and the profile convex (NAPo = 10 degrees), features also seen in the lateral headfilm. His facial photos show a long lower face height and lack of chin prominence. The intraoral views demonstrate the malocclusion with total anterior open bite.

Orthodontist, Ronald Ashley.

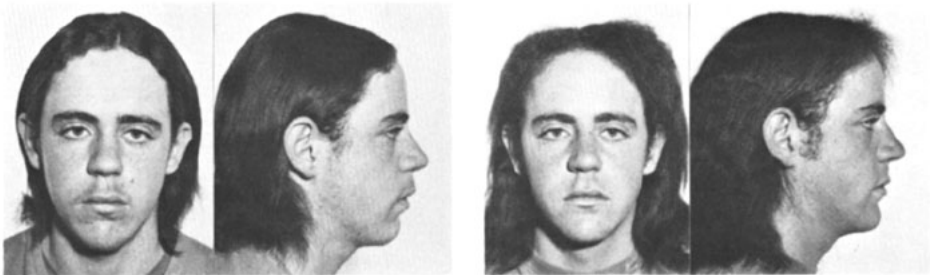
La Forte 1 Maxillary Osteotomy

The superimposed tracings at age 19 years, 8 months show rotation of the maxilla, 6 mm up in back and 6 mm down in front, rotating the palatal plane by 8 degrees. The mandible hinged up 6 degrees decreasing convexity (NAPo = 4 degrees). The lateral headfilm was taken soon after surgery and fixation wires can be seen.

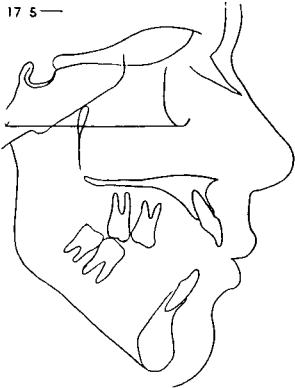
Oral surgeon, William Ware.

Final

Six months after surgery the lateral tracing shows correction of open bite and improved mandibular position, and the facial photos show the improved profile. The intraoral views show a very satisfactory occlusion.

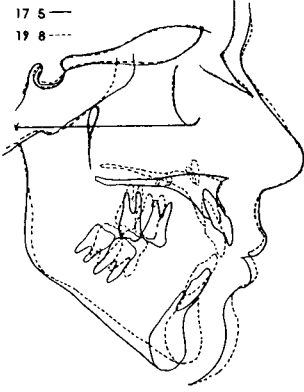


17 5 —

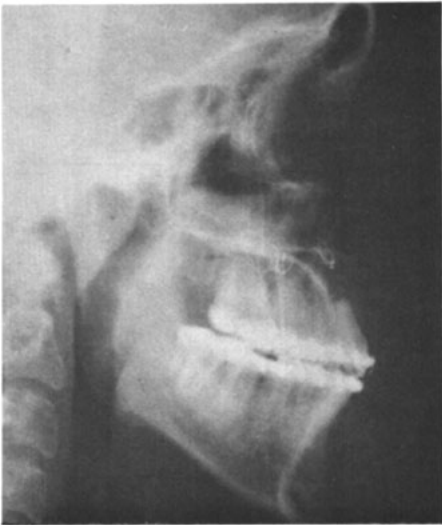
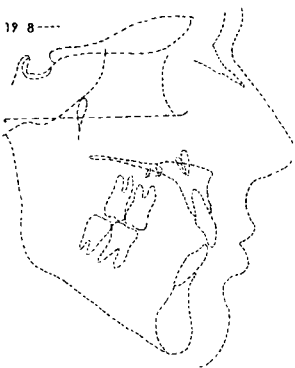


17 5 —

19 8 ----



19 8 ----



Original Case #7

The lateral headfilm tracing shows a very long lower face height with an anterior open bite and a steep mandible (MP to SN = 45 degrees) for a female age 18 years, 4 months. Her facial appearance shows the lips relaxed and parted and a high lip line.

Maxillary Osteotomy

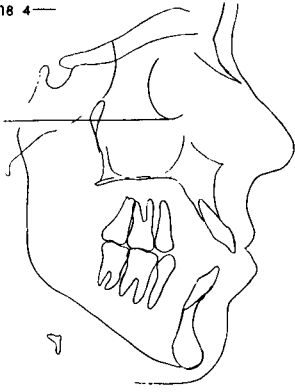
The maxilla was sectioned one month later into three parts for elevation and anterior retraction. Superimposed tracings show a 6 mm elevation of the maxillary posterior segments, but with 6 mm downward movement of the upper anterior teeth. The incisor open bite was corrected, but the posterior teeth were out of occlusion.

Oral surgeon, Howard Davis.

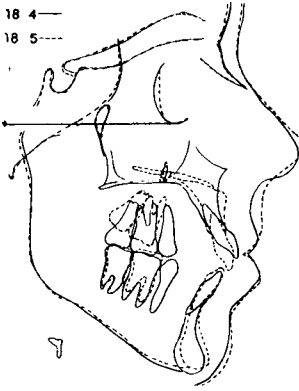
Final

Superimposed tracings made eleven months after initial records showing further changes obtained after surgery with the use of a high-pull headgear to the maxillary teeth and a chin-cup. The upper incisors were moved back up 6 mm allowing the mandible to hinge up and forward 4 degrees. The overbite remains normal. Facial photos show an unstrained lip closure, shortened face height, and increased chin prominence.

18 4—



18 4—
18 5-----



18 5-----
19 3—

