CHAPTER 2

Complications associated with orthognathic surgery

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It seems best to discuss complications of corrective surgical procedures of the jaws from the point of view of prevention or treatment rather than by a compilation of complications, their causes, and sequellae. A discussion of proper concepts and technique should be more valuable than a Cassandra's classification of calamities. Complications are reported rarely. Those mentioned or discussed in this chapter were obtained from a search of the literature, a survey of oral surgeons, personal communications, rumor, hearsay, and 20 years of experience in the teaching and practice of orthognathic surgery. Most of the problems are potential problems; they are real, they exist, but they should be in the background and can be avoided with good technique and management. Therefore most complications result from failure to follow proper precepts. Occasionally, however, a complication is seen or heard of that is so unusual that, to make it happen, thought and deliberation seem to have been required. Sound surgical judgment and observation of proved principles of surgery will avoid most complications, and this same sensibleness will cope with the inadvertent and unexpected.

It would be misleading to imply that following a chart or checklist would prevent all problems. Corrective surgery of the jaws is one of the most complex areas in which the oral surgeon functions. His concern must range from the life of the patient to the viability of a tooth. The added responsibility of changing the patient's appearance and self-image must not be viewed mechanistically or taken lightly. Because the unexpected and the unanticipated always can occur, the only surgeon who does not encounter complications is the surgeon who does not operate. The ability to cope with the unexpected, properly and handily, with a result that is satisfactory to the patient is the mark of a superior surgeon.

The selection of a patient for corrective procedures of the jaws involves more than the evaluation of health and the physiologic ability to undergo a particular procedure. The surgery is elective. No matter how critically the surgeon may see its need for
the patient to enjoy good dental health, better mastication, improved speech, and a more pleasing appearance, he must not let his enthusiasm sway the patient. Every person has his own self-image. A change in appearance—an improvement in the eyes of the surgeon and, perhaps, everyone else—may be undesirable or unwanted by the patient. Conversely, someone may desire a change in appearance that would be destructive to functional occlusion, teeth, and surrounding tissues. The patient should be given the opportunity to indicate his wishes or preferences on drawings, photographs, models, or moulages. When these desires are converted to a treatment plan the patient should be shown the anticipated results in the same manner. He must be apprised of the sequelae, both usual and unusual, anticipated and potential and, perhaps, he should be given the opportunity to meet with patients who have undergone similar surgery. Provided with the facts, the patient should have the privilege of making a free and uninfluenced decision.

Rapport with a patient cannot be established in a few moments, nor can a proper diagnosis be made at a glance or a treatment plan established by shifting two study casts in the hand. Most of the patients who are seeking secondary corrective surgery have thought that the surgeon was far too cursory in his diagnosis and perfunctory in his treatment plan. This situation has arisen most frequently when the surgeon did not have dental training, background, and experience. The surgical correction of jaw deformities is an art as well as a science. It is not enough to have an orthodontist make a cephalometric evaluation and a study-model treatment plan. It is not sufficient to have a prosthodontist indicate the desired freeway space and design a splint. It is not enough to be slick with a scalpel, saw, and suture. The surgeon must complement this surgical skill with knowledge of facial growth and development, an understanding of orofacial musculature, speech and swallowing patterns, and a thorough comprehension of occlusion. With these, along with empathy and understanding, he will be able to fulfill the patient's desires concerning appearance and still provide a comfortable, fully functioning organ of speech, deglutition, and mastication.

Because most complications go unreported, it is impossible to learn the full variety of what may and does go awry during and after surgery. Because the reported results of larger series of patients are those of surgeons who probably do more such procedures, and probably more skillfully, than the average surgeon, it is impossible to get a true estimate of the incidence of various complications. Therefore there unquestionably are complications that will not be mentioned here. Also, because of space limitations there will be certain procedures or combinations of procedures that will not be discussed. It seems best to eliminate those procedures that seldom are performed by oral surgeons in the United States. Similarly, the suggestions for avoiding or coping with complications are simply that—suggestions. They are mine and should not be taken as gospel. Every surgeon experienced in this field will have other, perhaps better suggestions. I can only tell you what I have learned by doing and teaching orthognathic surgery for the past 20 years.

Certain basics apply to all procedures: knowledge of anatomy and tissue physiology, proper technique, delicate handling of soft tissue, careful cutting of bone, and maximum use of time. To these must be added the key to successful orthognathic surgery—proper diagnosis and treatment planning. To the resident in oral surgery, the several hours spent in the operating room may be glamorous. But it is the many hours spent in planning that are the most significant. No one should operate on a patient without having worked out the procedures first, personally, on cephalograms and on models. Alternative procedures must be done in the same way. Then the surgeon will have a true feel for what has to be done, and he can make a more intelligent
choice. Yet despite all the measurements on radiographs, photographs, and models, orthognathic surgery still is in large part an art. Here, in diagnosis and treatment planning, and perhaps more than in any other area of this specialty, there is no substitute for experience.

For purposes of discussion, corrective surgical procedures will be classified as to whether they move the entire dental arch, a segment of the dental arch, or a nondental segment of the mandible. A brief description of the procedure will be given and complications will be listed, not necessarily in order of frequency or severity. This will be followed by a discussion of each complication with suggestions for prevention or treatment.

MANDIBLE
Movement of the entire arch—osteotomy of the ramus

Over the past hundred years, a variety of techniques for sectioning the mandibular ramus have been suggested. It may be approached intraorally, extraorally, or by a combination of both. It may be cut horizontally, vertically, sagittally, semicircularly, or obliquely at almost any level and at any angle. The condyle may be removed; the glenoid fossa may be filled in. Essentially, three of these procedures are widely used today.

**Subcondylar osteotomy**

The subcondylar osteotomy (Reiter procedure) sections the ramus from the mid-posterior border to the sigmoid notch. Through a small skin incision at the posterior border a wire saw is passed medial to the mandible to exit through the skin at the sigmoid notch. This method has the advantage of requiring the least operating time of any such procedure. It has the disadvantages of being blind, of having a high potential of facial nerve damage, and of having a reported high incidence of postoperative open bite. Among the complications encountered are hemorrhage, facial nerve disturbance, nonunion, open bite, and gustatory hyperhidrosis.

**Hemorrhage.** An absolute essential of proper technique is to hug the medial surface of the bone firmly with the tip of the wire passer (aneurysm needle) as it travels from the midpoint of the ramus to the sigmoid notch. By starting at the midpoint of the posterior border and by hugging the bone, the mandibular neurovascular bundle will be avoided. The mouth should be opened, and the aiming point should be posterior to the depth of the notch. However, on occasion, the masseceteric artery may be picked up and cut by the wire saw. I know of one instance in which this happened, and direct extraoral pressure for several minutes controlled the bleeding. Careful blunt dissection to the posterior border of the ramus before inserting the wire passer, protection of all soft tissues from the saw, and not making a stroke with the saw after the bone has been cut should prevent severing any other vessels.

**Facial nerve disturbance.** Disturbance of the facial nerve is particularly distressing in this procedure because the zygomatic and temporal branches may be affected rather than the marginal branch as in the submandibular approach to the ramus. As a result the patient may be unable to close his eyelid (Fig. 2-1, A). The chances of damaging the nerve will be minimized by a small skin incision just through the skin behind the midposterior border of the mandible, by gentle blunt dissection directly to bone, by protection of soft tissues as mentioned below, by not stroking the saw after the bone has been cut, and by removing the saw delicately. Branches of the nerve are present below the skin overlying the sigmoid notch. If the zygomaticotemporal branch is damaged and the patient is unable to close his eyelid, it should be closed and covered with a patch; the patient should be seen by an ophthalmologist. Almost invariably function will return (Fig. 2-1, B). In the interim, galvanic stimulation and exercises may be in order to maintain muscle tone.
There was one instance in which the facial nerve was not cut but in which weakness of one side of the face developed over several immediate postoperative days. This was attributed to pressure of the mandible against the tissues at the mastoid process. The symptoms were relieved by adjusting the intermaxillary fixation and by repositioning the mandible slightly forward on that side.

**Nonunion and open bite.** The principal objection to the subcondylar osteotomy is that there is a high incidence of nonunion and open bite. Although this has not been our experience, it is easy to visualize two reasons why it may occur. First, at best, this osteotomy provides a small area of bony contact for healing. The cut is short and narrow; the contours of the medial surface of the condylar segment and the lateral surface of the ramus do not match at their interface. Because of the small area of bone contact, the duration of intermaxillary fixation should be longer than it is in other techniques, particularly if it has been used bilaterally. Certainly this method should not be used to correct apertognathia. Second, as in all ramus procedures, the proximal (condylar) section must be lateral to the distal (ramus or body) section to ensure bony contact for healing. If the condylar segment is medial to the ramus, the lateral pterygoid muscle will pull it upward and medially, away from the ramus. There will be no bony contact, and nonunion will result. In an open procedure, as through a submandibular approach, the condylar segment can be visualized, grasped, and placed lateral to the ramus segment. In this blind procedure an attempt to guide the proximal segment is made by angulating the mediolateral plane of the osteotomy. The cut should be made so that it is higher (more cephalad) on the medial surface and lower on the lateral. Light upward and backward pressure against the chin may be employed to make certain that the mandible remains medial to the condylar segment when the osteotomy has been completed.

**Gustatory hyperhidrosis (auriculotemporal syndrome; Frey’s syndrome).** It is distressing for a patient to perspire along the side of his face whenever he salivates. This complication usually can be avoided by observing the precautions previously mentioned with emphasis on protecting the posterior soft tissues. A useful method of protecting soft tissue is as follows. A needle is obtained with a bore large enough for the wire saw to pass through easily. The point of the needle is removed, and two sections are cut, each about 3 cm. long. When the end of the wire passer appears through the skin above the sigmoid notch, a No. 0 silk suture is passed through the eyelet. The passer is
withdrawn, carrying the suture through the soft tissues behind the neck of the condyle. One section of the cut needle is passed over each end of the suture thread, moved gently through the soft tissues, and then held firmly against the underlying bone by an assistant. The wire saw is attached to one end of the suture and passed through the tube, medial to the mandible, and out the other tube. The handles are placed in the saw ends. As the surgeon strokes the saw, the assistants concentrate on holding the properly angulated tubes firmly and securely against bone.

Although the blind subcondylar osteotomy has limited applicability, it is a procedure that should be in every oral surgeon's repertoire. In essentially unilateral prognathisms it can be employed on the side requiring rotation, rather than retraction. In the rare instance in which a general anesthetic is contraindicated, this procedure can be done under a local anesthetic. This is employed for patients with fibrous ankylosis who cannot be intubated blindly while awake. The necks of the condyles are cut, the mouth is opened, and the patient is intubated. Then a condylectomy is performed.

**Oblique/Vertical Ramusotomy**

The oblique or vertical osteotomy\(^2\), \(^3\) of the ramus of the mandible through a submandibular approach is the technique used most extensively by oral surgeons in the United States today. Although there are various modifications of every step of this procedure, it usually involves a submandibular skin incision to the angle of the mandible, exposure of the lateral ramus surface, and sectioning of the ramus along a line drawn from the depth of the sigmoid notch to a point just above the angle. Among the complications associated with this technique are hemorrhage, facial nerve damage, mandibular nerve damage, inadvertent horizontal osteotomy, inability to obtain the desired repositioning, nonunion, open-bite, extrusion of teeth, infection, skin scars, keloids, parotid fistula, and condylar displacement.

**Hemorrhage.** With careful dissection from skin to bone there should be no problem with hemorrhage. Seldom is there a need to make an incision so large that the anterior facial vein and facial artery are encountered. If encountered, they may be retracted or, if necessary, tied and divided. If care is taken to elevate the peristemeum and to work within the peristeal envelope, bleeding may be encountered only from the massteric vessels, the medial pterygoid attachment, the ramus, and by severing the mandibular neurovascular bundle.

**Massteric vessels.** The sigmoid notch must be identified and the tissue must be gently freed sufficiently to permit a retractor to slip into place. An Obwegeser channel retractor is excellent for this purpose, since its cup will permit stroking of a Joseph or Stryker saw and movement of a bur while protecting the massteric artery and vein. If the massteric vessels are cut, packing and pressure should be applied immediately. A Kelly clamp can be kept holding the folded corner of a 4 x 8-inch gauze ready for such an occurrence. If the vessels are cut, the clamp with the sponge is inserted immediately into the wound and firmly held in place while additional pressure is exerted from outside the skin above. After several minutes the pressure is released. If bleeding still is present, the vessels may be clamped and tied with a tonsil-tie or the area may be packed again. On occasion, when bleeding occurred on the first side being operated on, the surgeon placed pressure packing, proceeded with surgery on the other side, and then returned to the first side.

**Medial pterygoid attachment.** When the attachment of the medial pterygoid muscle is stripped off the angle of the mandible, there may be bleeding. Packing with a sponge will control this easily. If a retractor is placed to protect the medial tissues from the saw blade or bur, it can apply pressure to a sponge beneath it.

**Ramus.** As the ramus is transected, some bleeding may be encountered. It is helpful to complete the superior and inferior portions of the cut before cutting completely through the midportion near the mandibular foramen. A ball burnisher (S. S. White
ceedures, and is less complex than the sagittal-split osteotomy.

Omitted from discussion are the vertical osteotomy through an intraoral approach, and other procedures on the ramus such as the inverted L, C osteotomy, decorticating, and mortising, all of which can be considered as modifications of this basic approach.

Unquestionably the most versatile of all procedures, the sagittal-split osteotomy of the rami permits movement of the body of the mandible in almost any direction. It is excellent for the correction of retrognathia and apertognathia, and, because of its intraoral approach, it may be the ramus procedure of choice for patients with severe acne or for those who develop keloids. This most noteworthy contribution of Obwegeser must be in the repertoire of any surgeon attempting to treat the wide variety of jaw deformities amenable to correction today. Unfortunately the versatility and broad applicability of this technique is matched by an extraordinary variety of potential complications. This is not a procedure for neophytes or novices; it is not meant for the solo surgeon nor for anyone not thoroughly trained, fully knowledgeable, and totally at ease doing extensive procedures intraorally. Even the most skillful of surgeons will not be at his best if he performs this procedure only occasionally. On the other hand, like open-heart surgery and kidney transplants, when the sagittal-split osteotomy is done regularly by a well-trained, well-equipped team the results are excellent and complications are rare.

In 1969, a survey of 644 board-qualified oral surgeons was made to obtain data for a comprehensive report on complications of the sagittal-split osteotomy. Repeated reference will be made to that survey. Those findings and those presented or obtained elsewhere will be compared with our experience at The New York Hospital–Cornell Medical Center. The complications have been categorized by degree of severity rather than by frequency of occurrence, that is, by whether they are life-threatening, disfiguring or potentially disfiguring, or subjectively discomforting. These complications are hemorrhage, airway obstruction and edema, substantial loss of bone (aseptic and septic), infection, displacement of bone segments, dislocation of the condyle, impairment of function of the facial, mandibular or lingual nerves, regression, relapse, nonunion, fracture, fragmentation, and limited mouth opening.

Potentially life-threatening complications

Hemorrhage. The 1970 survey indicated that airway obstruction and edema were the most serious life-threatening complications. Since then, however, there has been at least one fatality due to hemorrhage. In the survey, hemorrhage was reported by 39% of the respondents with half of these indicating it as a serious problem. Several of the episodes were nearly disastrous, with two requiring ligation of the carotid arteries and several requiring extensive blood replacement.

Lacerations of the maxillary, facial, and inferior alveolar arteries were the principal sources of severe hemorrhage, according to the survey. Others reported were the pterygoid plexus, the buccal soft tissues, and one "anomaly" that caused oozing from the split segments and required replacement of 2,000 ml of blood. (This apparently healthy patient had similar oozing when an anterior maxillary osteotomy was performed. We have had this experience with an anterior osteotomy also.) Of the two patients who had carotid ligations, one bled from an "unknown source" and the other when "... the periosteum was reflected too high on the buccal." The external carotid arteries were ligated without noticeably diminishing the flow of blood. Bleeding was controlled by extensive packing from an extraoral approach, and 4,000 ml of blood were replaced. One surgeon reported that he cut the maxillary artery on three different oc-
casions. In each instance, the accidental cutting occurred while he was making the horizontal (medial) bone cut. He thought that 
“... the bur spun off and caught the artery and lacerated it, in spite of the fact that there were retractors posterior to the border of the rami both lingually and buccally.” This same surgeon lacerated the facial artery in a similar fashion while making the buccal (vertical) cut. The facial artery was clamped and tied. The bleeding from a lacerated maxillary artery was more difficult to manage. It was stopped by pressure and “... extremely hot laparotomy packs soaked... so hot you could hardly hold them.” When bleeding was stanched, Surgeon was placed in the wound. Twenty-two percent of the reporting surgeons transfused patients, replacing 500 to 4,000 ml. of blood; one surgeon transfused all patients routinely. There were two patients who bled in the recovery room. Their wounds were packed blindly with Gelfoam with apparent success.

It is apparent that severe hemorrhage is a result of either improper reflection of the soft tissues or laceration of an inadequately protected vessel when bur cuts are made, when chisels are used for splitting, or when bone is removed after the mandible has been repositioned. In our series at The New York Hospital (136 sides at this writing) severe hemorrhage never has been a problem and transfusions are rare. This is attributable to careful dissection, constant protection of tissues with special retractors, and immediate attention to control any bleeding. Blood loss is monitored carefully by measuring the contents of the suction bottle and by weighing all sponges.

In my experience, however, there can be one irksome source of bleeding. This is the thin-walled retromandibular or posterior facial vein, which often lies just behind the periosteum at the posterior border of the ramus. By being careful not to penetrate or tear the periosteum when stripping it from the posterior border, either laterally or medially, or when positioning the channel retractors, either laterally or medially, this bleeding can be avoided. The markedly curved, rather than right angle, Obwegeser elevators should not be used at the posterior border until after the segments have been split and are movable. When venous bleeding does occur from the posterior border, it often can be controlled simply by downward pressure of the blunt rounded ends of the channel retractors while surgery proceeds. If this is not adequate, the bleeding should be controlled by packing a strip of 1-inch gauze from the buccal, medial, or both aspects (remember that the packing must be a long strip with a clamp at the end so that it cannot be left in the wound). While the packing is in place, surgery should proceed in another area; the buccal vertical bone cut can be made as may the connecting cut along the anterior border. If surgery has not been performed on the contralateral side, it can proceed. When that side is completed, attention can return to the first side. The packing must be removed gently and slowly.

If there is a secret to the successful performance of this procedure, insofar as bleeding is concerned, it is to operate completely within the periosteal envelope. Care should be taken to preserve its integrity when stripping it off the bone, when placing retractors (the retractor lips should face toward the bone, rather than toward the periosteum) and, particularly, when placing the medial channel retractor. There should be no soft tissue between the medial channel retractor and the surface of the bone. Insertion of a thin periosteal elevator (Obwegeser), in addition to the channel retractor, often will help protect the medial soft tissues from the bur. It is my opinion that compromises in technique are hazardous, and shortcuts should not be attempted until one has had substantial experience. This holds true for all phases of the procedure, not just those intended to prevent hemorrhage. As an example, the standard-size Obwegeser channel retractor should be positioned on the medial surface with its lip under the
posterior border of the mandible and nested in the lip of the lateral channel retractor. The inferior margin of the retractor should be positioned to protect the mandibular neurovascular bundle without pinching it against the lingula. The medial bone cut should be made with the Lindemann bur in a slow-speed handpiece. The handpiece should be firmly held, and the bur must not be allowed to spin off. Remember that it is at this point that most serious bleeding problems occur. Hoping to save a few moments of operating time by not dissecting to or by not retracting behind the posterior border of the ramus, by using small retractors, or by making the bone cut with high-speed drills may, instead, cause lacerated vessels, nerve damage or improper bone splitting, and unnecessary loss of time. The soft tissue should not be closed until bleeding is well controlled. At closure, a Hemo- vac® or similar system should be placed (as discussed more fully on p. 122). If this system continues to draw bright red blood, the incision should be opened, the source of bleeding determined, and the bleeding controlled. Certainly the patient should not leave the operating room if there is any indication of continuous bleeding.

Airway obstruction and edema. Postoperative edema of the larynx, pharynx, and soft tissues medial to the mandible, sufficient to interfere with the airway, was reported by 13% of the survey respondents. This condition ranged from “slight but disturbing” through “a nerve-shattering couple of days” to the need for tracheostomy in three patients. An additional 13% reported edema that was distressing, even “fantastic,” but that did not threaten the airway.

Some details concerning one of the patients requiring a tracheostomy are worthy of note. This patient was reported to have had the “usual edema” on the first postoperative day. On the second day there was “intensive” edema and respiratory embarrassment, and a tracheostomy was performed. Steroids (hydrocortisone succinate [Solu-Cortef]) had been administered preoperatively and during surgery in an attempt to minimize edema. This patient exhibited an unusual postoperative phenomenon, developing petechiae on his body wherever he was touched. The question of whether the steroids were responsible for this phenomenon and the extraordinary edema may be answered affirmatively.14, 15 It has been pointed out that there have been no well-controlled studies published indicating the effectiveness of any of the so-called antiedema agents, be they steroids, enzymes, or others.16 The need for tracheostomy in this patient, as well as other published reports, indicate that these agents may, in fact, sometimes be harmful.14, 15

At The New York Hospital, postoperative edema is recorded on all patients subjectively as mild, moderate, or severe. Facial photographs are taken on the first or second postoperative day. Between 3% and 4% of the edema has been considered severe; however, it never has interfered with the airway or with swallowing. Although there has been no apparent correlation between edema and operating time, there has been a distinct relation to pressure bandaging and possibly one to the menstrual cycle. Although pressure bandaging may reduce edema at angles of the jaws where it is not a problem, it does direct it toward the lips where it may interfere with inspiration. We do not bandage our patients. The patient with the most severe edema in our experience was a healthy 17-year-old girl whose surgery proceeded smoothly and rapidly (Fig. 2-4). But her menses had started on the day of the operation. Apparently because of the cyclic increase in sodium and water retention during the premenstrual days, increased edema may be expected during that period,14 although this may not be true during the actual days of menstruation.17 However, a second similar occurrence

*Snyder Hemovac, Zimmer Manufacturing Co., Warsaw, Ind.
Fig. 2-4. Edema after sagittal-split osteotomy performed at onset of menopause. A, 24 hours after operation. This was the most severe edema in The New York Hospital–Cornell series (Hemovac tubes repositioned for photograph). B, Normal facial contour of same patient.

Fig. 2-5. Hemovac tubes taped to face to prevent pressure on lips (photographs taken 24 hours after operation).
Current advances in oral surgery

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