THE TREATMENT OF BONY DEFECTS OF THE LOWER JAW*

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The author is convinced that no surgical lesion is generally so badly treated as infection and osteomyelitis of the inferior maxilla. This is due in the first place to timidity and ignorance on the part of the dentist who sees these patients in the beginning. His ill-advised attempts to save abscessed teeth lead to more or less widespread necrosis of the jaw. Secondly, the general surgeon frequently attacks the necrosed area with the curette and chisel with too great vigor, thus increasing the necrosis by trauma.

To particularize a little further, the dentist should not attempt to save badly broken-down teeth by putting on full-grown crowns embracing the entire root beneath the gums, as this is a potent cause of pyorrhea. Such teeth should be extracted before abscesses develop. In case an abscess has occurred, no delay should be followed in removing the abscessed tooth. If the abscess is simply around the root of the tooth and has not invaded the gum, extraction may be all that is necessary. If the infection has had time to invade the bone, the abscess will not be aborted by simple extraction of the tooth. How often patients say “My dentist would not extract the tooth until the swelling went down!” With most dentists this seems to be an axiom. Every so-called “gum boil” should first have the tooth extracted, this to be immediately followed by a good, free incision along the alveolar process directly over apex of infected tooth, following infiltration of the gum with 2 per cent. novocaine solution. If free drainage is not obtained, an incision should be made under the inferior maxilla at point of fluctuation, parallel with inferior border of maxilla. By early extraction and free incision inside the mouth, the acute condition is usually controlled.

The treatment of chronic osteomyelitis of the lower jaw should consist chiefly in establishing and maintaining good drainage and in free, frequent irrigations through the sinuses, which should be frequently probed to ascertain whether or not free sequestra are present. The surgeon should resist the first impulse to vigorously curette these sinuses, as by this means it is very easy for him to increase the area of the necrosis by injuring the delicate new bone cells that are forming

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in the osteogenetic, periosteal layer. A waiting policy should be adopted, allowing nature herself to make the separation of dead from living bone. The periosteum should not be traumatized by the curette and should always be preserved. Gentle curetting later of the bony sinuses to remove necrosed particles, avoiding the periosteum, is allowable. When large, free sequestra are evidenced by the probe, the sinuses should be enlarged sufficiently to permit of the extraction of the loose sequestrum. The curette has been responsible for much damage to otherwise healthy bone and in many patients has simply increased the necrosis.

The treatment of defects in the entire vertical diameter of the lower jaw involves much thought and care and patience both on the part of the surgeon and the patient. At the outset, the surgeon should come to a thorough understanding with the patient, explaining that much patience will be required, since it may be necessary to graft two or three times, in case infection sets in after the grafting, also that it will be necessary to have the jaw fixed either by wiring the upper and lower teeth together or else by some suitable apparatus. Only by absolute cooperation between the surgeon and the patient can a good result be obtained. In a patient with extensive necrosis, where the remaining bone is thin and weak, the patient should be warned not to chew upon hard objects in order to prevent a fracture taking place. If a fracture should occur in conjunction with necrosis, the upper and lower teeth should be held in their proper, original occlusion by wiring the upper to the lower teeth, or by the fitting of some suitable apparatus which will be described later. If there result a space between the fragments when the teeth are held in their proper relations, then one may expect a filling in of a not too large defect by new bone, provided that the periosteum has not been destroyed by the infection or been injured or removed by too vigorous curetting by the general surgeon. In rare instances, the vertical defect may be large, resulting in one of two things: first, if the fragments have not been properly held, they may fall together and unite in such a position that chewing is impossible, due to the posterior displacement of the shortened lower jaw. It will be necessary in such a case to sever the point of union, to separate the fragments, to hold them in their proper relations until the opening into the mouth cavity is closed off, and then, later, to graft a piece of bone, or cartilage, into the defect. Second, the defect with the teeth held in proper alignment may be too large to fill in of itself, resulting in non-union, to remedy which grafting will be necessary. Let us instance a typical case to illustrate the procedures. In most instances the patient will be seen with a sinus discharging under the lower jaw. The teeth have not been held in their proper positions
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and the ends of the fragments have fallen together, where they may or may not have united. There may be inability to chew solid food owing to the posterior displacement of the lower jaw. The first thing to be done is to enlarge the sinuses, then to remove any loose sequestra. If none are loose, a small curette may be introduced and the bone may be gently curetted, avoiding contact with the periosteum. Then the surgeon should patiently wait for the healing of all the sinuses and the expulsion of the sequestra, meantime having the patient frequently irrigate the sinuses. If the patient is seen before the fragments have fallen together, then the upper and lower teeth should be held in their proper positions by wiring them together, or by adjusting some suitable apparatus. In all this work it is most advisable for the general surgeon to associate with himself a dental surgeon who shall have charge of maintaining proper occlusion of the teeth. In my hands, wiring of the teeth has proved a better and easier method of maintaining them in proper position than apparatus. After the sinuses have entirely healed, then the surgeon should consider the best means of filling in the defect. The grafting of either a segment of bone or cartilage into the defect is certainly the only rational line of treatment. This must be carried out with minutest attention to details. The first operation is preceded a few days by the fitting to the upper and lower teeth of Angle’s gold or German silver fracture bands with loops on the buccal surfaces. At the operation an incision is made along the lower outer border of the jaw, the point of non-union is exposed, cicatricial tissue is divided, opening into the mouth as little as possible, though this is almost unavoidable. The fragments are forcibly separated by some instrument which can be gradually opened, a most efficient apparatus in my hands being a mouth gag which is provided with two movable mouth jaws which are opened by a screw (pulmotor outfit). After the fragments are sufficiently separated, bronze wires are fastened between the upper and lower loops of the fracture bands, thus permanently maintaining the width of the defect. The mouth will most certainly have been opened in this procedure, rendering grafting at this time futile because of the resultant infection. The wound is sewn up without drainage and allowed to solidly heal for several weeks before attempting any grafting procedure, the defect between the fragments being carefully maintained during this time by rigid, frequent inspection of the wires, which are apt to become loose. At best infection is the “bête noire” of bone grafting operations into the lower jaw. The immediate proximity of the graft to the mouth renders the maintenance of sterility very difficult even with an intact covering of the graft, hence the most excessive precautions should be
taken in making the graft, always using Lane's fracture technic. In the first place the old scar is cautiously opened from below, exposing the lower borders of the two fragments. Working from below upward, the vertical margins of the fragments are bluntly freed for a short distance, avoiding the tissues on the posterior or inner surfaces, and the edges of the bone are freshened with the rongeur. A portion of the outer surfaces of the fragments is laid bare with the periosteal elevator, care being taken not to open into the mouth. Should the mouth be opened into, no grafting should be done at this time, but the wound should first be allowed to solidly heal, when another grafting attempt may be made. Of help in preventing the opening into the mouth is to have an assistant keep a finger in the mouth in the defect to tell when a dangerous approach is being made toward the mouth. It cannot be too strongly emphasized that the smallest opening made into the mouth at the place of grafting is an absolute contra-indication to grafting, for immediate infection of the graft from the mouth produces, without exception, death of the entire graft with its subsequent extrusion. On the other hand, a sluggish infection, not arising from direct contact with the mouth, which develops in the wound some days after the grafting, may have no subsequent deleterious influence on the entire graft, only a part of the graft necrosing away, this having occurred in three of my cases with eventual good results. In one of my cases, a soldier in France, the mouth was opened at the time of grafting, though this was unknown to me at the time of grafting. There was a copious, foul-mouth infection evidenced on the second day by a profuse discharge, which ultimately resulted in the death of the whole graft. My departure from France took place before I could re-graft the defect the second time. During the entire grafting operation the most scrupulous Lane technic must be followed: that is, sterile towels should be clamped to the edges of the wound to exclude contact with the skin. Then no part of any instrument touching the tissues of the wound should come in contact with the operator's hands in any manner. All instruments when once used should be re-boiled before use again. All ligatures and sutures should be passed and tied with instruments without contact with the hands. Only by such means can the conscience of the surgeon be free in case infection subsequently occurs. Infection at best is difficult to avoid even with the most scrupulous technic just outlined, because the covering of the graft with soft parts, separating it from the mouth, is necessarily very thin and these tissues are largely cicatricial in which the blood supply is necessarily very poor and, in consequence, the resistance of the graft to infection is bad. I cannot
agree with Albee that a bone graft is at all resistant to infection. It is badly vitalized tissue, poorly supplied with blood, and in my experience much more liable to infection than normal tissues. It would be very advantageous if we could graft into a jaw defect some tissue more resistant to infection than bone. With this in view the suggestion of Morestin seems most valuable. He uses costal cartilage instead of bone in making grafts into the lower jaw, maintaining that the resistance of cartilage to infection far surpasses that of bone, that cartilage does not become absorbed and that it can be very easily cut with the knife to any desired shape. The seventh or eighth costal cartilage can very easily be removed entirely or a segment may be cut out of one of them. It is beautifully tolerated by the tissues. It may be inserted end-to-end and held there by sutures or be inlaid just like a bone graft. In my next lower jaw grafting I purpose using cartilage instead of bone for reasons already given. To return to the bone grafting interrupted above, the vertical edges of the fragments having been freshened and the outer surfaces laid bare, transverse grooves are cut in the outer surfaces of the two fragments for at least an inch long with either a chisel or the twin motor saws. Two holes on each fragment are drilled from the sides, running into the grooves. Kangaroo tendon sutures are then threaded through these holes. A corresponding sized graft with the covering periosteum, the latter taken larger than the bone transplant itself, is cut out of the tibia with the marrow also. No hand touches this graft at any time. The graft is placed in the grooves prepared in the lower jaw under the kangaroo sutures which are then tied with instruments over the transplant, securely holding the graft in place. I formerly used metal sutures but have now substituted for them kangaroo tendon or chromic gut, since these have less tendency to invite suppuration than non-absorbable sutures. The wound is then closed by suturing the deep tissues securely over the graft and in contact with it and over this the skin is sutured separately. Before the anaesthesia is completed, care should be taken to see that the wiring of the teeth is securely and accurately maintained. A dressing is applied to the wound and between the dressing and the mouth a sheet of rubber tissue is glued with ether to the skin to exclude the possibility of dribbling from the mouth reaching the wound. The after-treatment consists in careful, frequent watching of the wires between the teeth to see that they do not become loose or broken. There must be no mobility whatsoever between the fragments for three months, for movement is fatal to grafts. In my experience the wires will have to be readjusted, tightened or replaced on an average of every two weeks. The patient is fed soft diet through any existing
cavities in the teeth, or liquid diet may be administered. Feeding has not furnished any difficulties in any of my cases and none of the patients have complained of this. For various types of splints to hold the jaws see Morestin and Mitchell.

A second method of grafting is to place the ends of the grafts in contact with the freshened ends of the fragments, with or without kangaroo tendon sutures being passed through holes drilled in the extremities. This method does not hold out so good a prospect for life of the graft owing to the contact of bone to bone being much less. In addition the danger of opening the mouth is greater, since a larger posterior surface of the fragments has to be freed and laid bare. Such grafts have, however, the advantage of wedging the fragments apart.

The main lessons to be learned from these patients are as follows:

1. Infection from the mouth at the time of making the grafts is absolutely fatal to the entire graft.

2. Infection appearing weeks after the grafting, not dependent on immediate connection with the mouth, is by no means fatal to the entire graft. A part only of the graft may necrose away.

3. No grafting should be made in the presence of a sinus or into a granulating cavity.

4. Grafting should be performed any number of times until a successful result is obtained.

5. In view of the great liability of bone grafts into the lower jaw to infection, the author is inclined in his next cases to use costal cartilage as grafting material, since this is more viable than bony grafts and is not so liable to become infected.

6. Absolute immobility of the lower jaw is a sine qua non to a successful result. Wiring the teeth has proved, in the author's experience, more successful than splints. It should be maintained for three or four months after the grafting.

7. The inlaying of the graft (always with its periosteum) into grooves cut in the sides of the fragments would seem to be a more scientific procedure than an end-to-end grafting.

8. Metal sutures had best not be used, owing to their liability to invite infection.

CASE I.—Previously reported. Result fine. The patient died a year after the grafting of pneumonia. Dr. Downes saw the patient before her death and will testify to the good result.

CASE II.—The first grafting in this patient was reported previously. The report of the second grafting has not been published and is as follows:

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J. O., Italian woman, forty years of age. Prior to the first grafting, consolidation had taken place in such a bad position that chewing of solids was impossible. The site of consolidation was chiselled through, the fragments separated and later a bone graft was inserted which was held with metal sutures. There occurred infection of the graft which necessitated its entire removal. The wound had entirely healed, the teeth being held as well as possible with wires in their proper relations, thus maintaining the defect. This was difficult, as the patient lived in the country, could speak no English, and always returned with the wires loose or broken.

Second bone grafting operation, May 18, 1915 (Fig. 1). Intranasal ether anaesthesia. Incisions along old scar in lower cheek; curved incision with convexity inward along right tibia. Pathology: The defect was dissected out, measured 2 or 2½ inches long transversely. The posterior fragment ended in a thin plate of bone anteriorly. The total vertical diameter of the bone had necrosed away. The lower teeth which remain have been wired to upper, maintaining the defect. Procedure: Old scar circumscribed and skin surface of cicatrix removed. End of anterior fragment exposed and cleared of tissue. Edge freshened with chisel. Posterior fragment exposed deep in tissues under masseter muscle. Was a thin bony sheet. Tissue reflected from both its surfaces for an inch. Hole drilled ½ inch from its edge. Drill hole in anterior fragment. The tissues between the fragments were carefully separated, an assistant's finger being in the mouth to prevent entering into it. Lane's technic throughout. Right tibia exposed. Length of bone required measured off and the periosteum cut ½ inch longer all about and divided. Motor saw cut the graft exactly as laid out and went into medullary canal, erroneously including the crest. Width of graft about ¼ inch, thickness about ¼ inch, and length about 2 inches. Each fragment end drilled. Chromic gut used. Periosteal surface of graft was placed in the defect toward mucous membrane of mouth posteriorly, the posterior side of graft was placed on outer side of the posterior fragment and held there by chromic suture (Fig. 1). Anteriorly a step was made in side of anterior fragment and into this the blunt, anterior end of graft was fitted and held there by chromic suture through drill hole in anterior fragment and through drill hole cut in the anterior end of the graft. Graft fitted finally beautifully in place. A small piece of the graft which had been cut off, measuring about ½ inch square with periosteum on it, was placed next to graft posteriorly as an additional osteogenetic stimulus and was covered over by the
surrounding tissues. Whole graft buried by plain catgut suture, bringing tissues over in front of it. Interrupted silk sutures in skin.

Went home on June 4, where she broke her grafted leg by tripping. Treated at home by family doctor with splints for 40 days.


September 30: All wires removed. Great difficulty in wearing them because she invariably broke them. Graft feels finely.

Fig. 2 shows the graft seventeen months after it was implanted. Chews well. Motions of jaw perfect. Graft intact and solidly united.

Case III.—Previously reported. This patient shows the value of periosteum on a graft. In 55 per cent. of my experiments on bone grafting if the transplant was without the periosteum the graft disappeared. In this case it was entirely gone in five months. In November, 1910, I removed half the lower jaw from a lad of 12 for a large giant-cell sarcoma. Fifteen months later I grafted into the defect in the lower jaw a piece of rib which was entirely stripped of its periosteum. One end of the rib was bevelled and this was sutured to the freshened edge of the remaining half of the jaw. The wound healed by primary union. Five months later a röntgenogram showed entire disappearance of grafted rib. There never was any discharge from scar.

Case IV.—This patient was a soldier in France suffering from a shell wound of cheek, upper lip and nose, and with the loss of an inch and a half of the entire vertical diameter of the lower jaw (Fig. 3). The left half of the lower jaw was maintained by wiring it in its proper relations to the upper teeth during the entire healing process. Several plastic operations were necessary upon the soft parts. The final result of these is shown in Fig. 4. I grafted a piece of bone from his tibia with periosteum, end to end, in the defect, suturing it with chromic gut. Unfortunately I did not appreciate at that time that I had minutely perforated the mucous membrane of the mouth. A foul discharge immediately set in, resulting in the death of the entire graft which had to be removed in toto. I left France before I could re-graft this patient. I learned that he was subsequently sent to the Hôtel Dieu to be under the care of Professor Morestin.


Five and one-half months ago shotgun, accidentally discharged, caused large laceration of left side of chin and compound fracture of mandible. Three and a half months later (early part of March), while a sinus discharging pus was present, a Lane plate was inserted in another hospital, between the fragments. This
FIG. 1.—Case II. Shows end-to-end graft from tibia with periosteum held by kangaroo tendon sutures through drill holes.

FIG. 2.—Case II. Shows graft seventeen months after it was implanted. It was firmly consolidated with the ends of each fragment.
Fig. 3.—Case IV. Shell wound of face of French soldier, involving lower cheek, lower jaw, upper lip and nose. The loss of bone in lower jaw was one and a half inches longitudinally and involved the entire vertical diameter.

Fig. 4.—Case IV. Final result of plastic operations on face.
Fig. 5.—Case V. Shows improper closure of defect by a Lane plate, as this caused malocclusion of the teeth. Also shows buckshot peppering the tissues. These were not removed.

Fig. 6.—Case V. Result after removing the Lane plate, separating the fragments sufficiently to make proper occlusion between the teeth and wiring the upper and lower teeth in their proper positions. This brought out the defect.
FIG. 7.—Case V. Shows the graft from the tibia inserted into grooves cut in the outer surfaces of the fragments.

FIG. 8.—Case V. Sequestrum of graft which was removed three months after operation.
FIG. 9.—Case V. Shows plaster helmet and chest extension made to hold hand against cheek while pedicled flap from forearm was healing into cheek.

FIG. 10.—Case V. Shows result of grafting skin and fat, pedicled to the forearm, into the depression of the cheek.
FIG. 11.—Case V. Röntgenogram of defect in lower jaw. It has solidly filled in with bone from the graft despite the sequestration of part of it. Taken three months after the grafting.

FIG. 12.—Case VI. Shows defect made by bringing lower teeth in proper alignment with upper, where they were wired.
Fig. 13.—Case VI. Shows end-to-end graft from clavicle in position, pedicled by soft parts, held by kangaroo sutures.
loosened in two and a half weeks. A sinus persisted till two weeks ago, when it closed (Fig. 5).

Examination.—On the left side of the lower jaw is a large, stellate scar with a depressed centre attached to the bone beneath. The mouth can be opened only one-third its normal extent. On closing the teeth the lower incisors are posteriorly placed one inch behind the upper, rendering effective chewing impossible. There is evidently a loss of substance of about an inch in the vertical diameter of the left side of the lower jaw with considerable mobility of the fragments. There is no sinus. Röntgenogram showed the neck studded with buckshot and there was a loose Lane plate between the ends of the fragments (Fig. 5).

First Operation (May 11, 1916).—Intranasal ether anaesthesia, through tubes in the nose. Incision: Transverse along left lower jaw beneath the defect.

Pathology.—Non-union of the fragments which had approximated each other on the left side. The defect, when the fragments were separated into their proper positions, measured about one inch transversely. With the fragments unreduced there was no approximation of the lower teeth to the upper, the right larger fragment being drawn over to the left so that the lower teeth were one inch posterior to the line of the upper teeth. There was no dead bone evident anywhere.

Procedure.—Fragments exposed and search made for the Lane plate with two screws as seen in the X-ray plate. This withdrawn after exposing it. Fragments were separated to their proper relations and were wired in these positions to the upper teeth by Dr. V. E. Mitchell (Fig. 6). In making the separation the mouth was opened. Rubber tissue drain externally in middle of wound. Continuous silk skin suture. No attempt was made to extract the numerous buckshot. None were seen in the wound during the operation. A future lead-poisoning from these retained lead bullets is a possibility but scarcely a probability. Very few cases of such subsequently occurring are on record.

Comment.—The previous application of a Lane plate in this way was a wrong procedure, for, by bringing the ends of the fragments together, malocclusion would have resulted had they healed in this shortened position. Instead the teeth should have been wired together in their proper relations.

After-result.—The wound healed almost by primary union.

Second Operation (June 7, 1916).—Bone graft from tibia into defect in lower jaw (Fig. 7). Intranasal ether. Incision along under side and parallel to lower border left jaw. In right leg middle, curved incision with convexity anterior.

Pathology.—Defect in lower left jaw one inch in breadth just
posterior to middle line. Filled up with scar tissue. Defect had been fully maintained by wiring the separated fragments in their proper relations to upper jaw. Since first operation, clean wound.

Procedure.—Lower borders of the defect developed by separating the soft parts from them and this continued along the outer surfaces for an inch away from their free borders. In making a furrow across the defect carefully through the scar tissue a suspicious bubble occurred once as though the mouth was opened into by a minute perforation but there was no certainty. Along the outer surface of the posterior fragment a furrow was cut with the chisel and its edges were drilled in two places running into the furrow. Kangaroo tendons were threaded through the holes. In the anterior fragment a furrow was cut with the twin motor saws and holes were drilled in its lower border and kangaroo tendons threaded through them. From the right tibia was cut a segment with its periosteum intact, about three inches long, with the twin saws. The crest was not included in the section. There was marrow on the fragment. The graft was inserted in the furrows in front and behind and the kangaroo sutures were tied. There were two sutures on the anterior fragment and one on the posterior. The fit was very good. The skin edges were loosened up. Deep plain catgut sutures partially brought the deep tissues over the graft and the skin was sutured together with plain silk interrupted sutures. A starch bandage was placed under and around the chin and over the head. Rigid Lane technic was maintained throughout. The graft was not touched by the fingers at any time. No drainage.

After-result.—The skin over the graft was evidently too thin and cicatrical to remain viable with the amount of tension present. Two weeks after the operation there was some necrosis of its skin edges, exposing the graft beneath. This never closed. For three months the teeth were maintained immovable by wires. By this time a sequestrum (Fig. 8) had separated from the graft, and on September 12, 1916, it was lifted out by enlarging the sinus in each direction under novocaine anesthesia. The wound healed solidly immediately thereafter. There was solid union between the fragments and all the wires were removed three and a half months after the grafting. There was considerable stiffness of motion in the lower jaw at first, but by the patient forcing the lower jaw down with his fingers continually a very good opening of the jaw was obtained. Chewing has been perfect since that date. A plate provided with four false teeth was made to fill the defect inside the mouth. The result has been perfect.

The patient was not satisfied with the depressed scar on his face so I agreed to try to remedy this. I have never had success
with the Krause or Wolff free grafts, consisting of the entire thickness of the skin, although Krause reports a number of such graftings into the face with success. Presumably the rich facial blood supply has had much to do with this. I determined to transfer a flap of the whole thickness of the skin with the fat pedicled to the forearm, into the freshened defect.

*Fourth Operation* (September 27, 1916).—Intranasal ether. Plaster helmet (Fig. 9) was made the day before operation, going around shoulders and with a prolongation to support right arm. Scar in cheek dissected all out and loosened up from the underlying tissues, resulting in a triangular raw area, whose base below was two inches, with apex above. Right forearm prepared and a flap three times as large as necessary to fill the defect dissected from middle of forearm with base towards wrist and about three inches long, the fat being included in the flap. This was turned so the raw surface came against the raw surface of the defect and its tip sutured with finest silkworm gut to the skin edge of the face posteriorly and also as far below as possible. Hand then bound to head helmet with plaster bandages and plaster also applied about chest and right arm.

*After-result.*—The patient suffered so much from the confined, high position of the forearm that on the ninth day after the formation of the flap, it was determined to sever the flap.

*Fifth Operation.*—After being made unconscious, flap was divided close to forearm. Plaster helmet was then divided and removed. The edges of the flap were trimmed and some of the under surface of the flap. The flap was adherent for one inch posteriorly to the skin of the face. Anteriorly, the depressed portion of the scar was excised and the edges lifted up. All about the defect the edges were freshened. The defect was triangular with base below of about two inches length. The flap was trimmed so that it filled the defect without tension. It was sutured to the face by finest silkworm gut sutures. Under its lower edge a slip of rubber tissue drain was placed. The result was good. Over the graft rubber mesh was placed and gauze wet in salt solution. The raw area in arm was covered in spots by the entire thickness of the remnants of the face flap, cut in small pieces, from which all the fat was removed, Wolff grafts. These were covered with rubber mesh.

*After-result.*—The graft into the face took almost by primary union, except at its most anterior edge, where there was a slight necrosis. Much to my surprise the Krause grafts into the forearm all took beautifully. It was later thought best to apply some "pinch" skin grafts to close the remainder of the forearm wound. The patient is to be congratulated on his patience in enduring all these procedures, but the good result has well repaid him. The
defect has become filled in with new bone (Fig. 11) and the alignment between the upper and lower teeth as well, as the movements of the jaw are sufficiently satisfactory to perform mastication perfectly. In addition the scar has been made much less disfiguring (Fig. 10). I should like to ask the members of the Society what success they have had with the Krause-Wolff free skin grafts and whether I would have been justified in making such a graft in this patient's face?

Case VI.—H. C., colored, aged thirty-three, admitted August 26, 1915. Sent to me by Dr. H. S. Dunning from the Dental College. On March 16, 1914, patient was struck with a "black jack" which produced a compound fracture of the lower jaw. The fracture was a little to the right of the symphysis. Inflammation and swelling set in and he went to a hospital, where a piece of bone was taken from the jaw and four teeth were extracted. In six weeks the sinus had healed, but he could not chew his food. For ten months, at intervals of two weeks or more, there was much pain in the jaw, it was hot and tender, relief being felt when pus was discharged. At present the patient can open his mouth only half its normal extent and cannot chew. Examination shows an irregular scar with two sinuses, each exuding a drop of pus, in the middle of the right ramus of the mandible. Right ramus is angulated inward; left ramus has fallen in to fill up defect in bone, producing no occlusion whatsoever to teeth. There are motion and crepitus at the fracture spot.

First Operation (August 27, 1915).—Intranasal ether. Incision along right lower jaw.

Pathology.—The left half of the jaw had drawn over to the right to fill up the defect of an inch transversely, consisting of the entire vertical diameter. No attempt was to be made to graft bone from the tibia into the defect until all the sinuses should have closed. Infection came from the roots of two teeth which had to be extracted. These roots opened directly into the operative wound. No dead bone seen.

Procedure.—Incision carried down to the edges of the defect. A projecting lower, pointed end of a tooth was seen above. This tooth drawn and one anterior to it. This opened the mouth and later the mucous membrane had to be opened for at least an inch. The defect was then increased by drawing the left half of the jaw over until it came in its proper relation with the upper, where it was wired to the teeth. The defect between the bones was then at least an inch wide and one looked directly through the defect from the outside into the mouth. No dead bone visible anywhere. Mucous membrane sewn over the defect with catgut. Rubber tissue drain followed by continuous black silk suture in skin.
**After-result.**—For three weeks food and saliva came through the wound, then the wound healed solidly.

**Second Operation** (September 15, 1915).—Intranasal ether. Incision over left side of lower jaw through old scar.

**Pathology.**—Teeth had been wired in their proper relations and held so. The defect (Fig. 12) was about 1½ inches to be filled. This area was filled with scar tissue. After opening into the mouth by accident it was deemed inadvisable to graft because of infection. As it was impossible to open the scar again without opening the mouth if it were allowed to heal, the wound was packed.

**Procedure.**—Scar opened cautiously. Ends of fragments exposed and freed. The anterior fragment was rough, so it was smoothed off with the rongeur. The posterior fragment was a thin plate, necrosis had removed all the horizontal plate posteriorly. On attempting to make a furrow in the soft parts, the mouth was opened. The opening was about the size of a dime. This was sewn up with plain gut. It was thought best to try to let the cavity granulate and then to graft into this later. Wound strewn with aristol and packed. Starch bandage about the head.

**After-result.**—Very little discharge from the wound and practically no mouth discharge. October 5, 1915, granulating cavity was half closed in, and mouth was entirely shut off. Had been dressed with aristol. Wires had been removed, because they became loose very easily, and an interdental splint made by Dr. Mitchell was substituted, which was worn at time of operation.

**Third Operation** (October 5, 1915) (Fig. 13).—Intranasal ether. At each of the two preceding operations to make a furrow to lodge the graft, the mouth was opened. So at the end of the second operation I decided to close the mucous membrane of the mouth off with sutures and to let the remainder of the wound granulate and into this granulating cavity to insert later the graft. Since a pedicled graft is more liable to live in the presence of infection than a free graft, it was decided to pedicle with the overlying skin a graft from the clavicle into the defect. A free graft in the presence of infection *might* live, but it would be very uncertain, since infection was known to be present.

The original incision in the jaw was prolonged anteriorly over the ends of the bones. The whole incision was scraped out so as to remove the granulating tissue from the soft parts, and tincture of iodine was applied. The anterior end of the bone was laid bare and was very thick through. Rongeur freshened the edge. Hole bored through the end transversely. The posterior edge was freed and freshened with the rongeur and drilled through, its anterior surface being pried free of tissue. Exact length of defect measured with piece of rubber tissue. This laid on clavicle and marked out as being the length of bone desired. Skin
incision made half an inch wider on each side and carried down in a circle one inch below clavicle on chest. It was surprising how much the skin contracted when divided. Flap dissected half-way to lower jaw, going beneath deep fascia and platysma. Transverse division of periosteum on clavicle, the length of the graft being about one inch and a half. Longitudinal anterior division of clavicle for requisite length into medullary cavity and posterior transverse division by motor saw. This motor saw was supplemented by metacarpal saw. Small chisels then inserted broke off the graft from posterior part of clavicle with division of posterior periosteum somewhat larger than the bone graft. Incisions then made up vertically along the neck, carrying the original lateral incisions up, dividing the platysma and reflecting this up with the flap. It was necessary to make the flap up to the middle of the neck before it could be reflected into the defect, where it was twisted upon itself to bring the skin surface external. Drill holes made on each end of the graft. Kangaroo tendons threaded anteriorly and posteriorly and tied. Graft in good position between ends of bones (Fig. 13). Upper margin of skin edge sutured to upper edge of defect with interrupted black silk. Two plain catgut sutures between lower edge of defect and skin over graft. Remainder of wound closed with black silk. Considerable undermining had to be done before tissues came together over neck and shoulder. At first fascia brought over defect in clavicle by three catgut sutures, then side-to-side union of upper part of skin defect and the final closure was made by an inverted "T," the cross-bar being on the shoulder. Interrupted silkworm gut sutures used. Rigorous Lane technic throughout.

After-result.—At the end of a week there was gangrene of the pedicle which had to be cut away in consequence. For a time it looked as though the graft might live but this proved illusory. The infection was too much for the graft to retain its life. It finally entirely sloughed and had to be removed. During an absence in France, I lost track of this patient and now I cannot find him. I should try to persuade him to let me graft his jaw again could I see him. As a result of this procedure I doubt if I should again attempt to transplant a bone graft into a granulating cavity, although several such successful graftings have been reported.

REFERENCES