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RECONSTRUCTIVE SURGERY OF THE HAND*

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One of the most perplexing problems that were presented to the orthopedic surgeon during the war was the restoration of function in injuries of the hand. Each case presented many difficulties rather than a single problem. Complete restoration of function, or as nearly complete restoration as possible, is essential before the full duty of the surgeon to the soldier is fulfilled. An all too frequent mistake has been to send the man with imperfect function of the hand to his home to work out motion in the wrist or some of the small joints of the hand by himself. Many of these men live in remote districts and will never come under medical supervision again.

It has not seemed practicable to divide this subject in any way; therefore an attempt will be made to paint the picture as it actually presents itself. Injuries of the wrist joint will be considered in a general way because of the necessity of securing the proper relation of the hand to the forearm.

INJURIES TO SOFT PARTS

Dorsal Surface of the Hand.—These wounds were found to be due for the most part to machine gun bullets or fragments of shell casing, and as a general rule they were of the oblique type. The dorsal surface of the hand is exposed to projectiles to a greater extent than the palm because of the position assumed when it is hanging by the side or when it is active. Cicatricial tissue follows these wounds because of the presence of infection in all instances. The scars are unsightly, often tender and easily abraded, but they interfere to a lesser degree than does the presence of scar tissue in the palm of the hand.

Frequently, cicatrices of the dorsum of the hand may be excised and the skin freed sufficiently to allow closure of the defect due to the removal of the scar tissue. In case this procedure is followed, care must be taken to preserve the circulation in all parts of the skin flaps, for, although an occasional small skin

slough has occurred, this method of skin repair has proved satisfactory.

Palmar Surface of the Hand.—Extensive scarring of the palm of the hand may lead to contractures of the thumb, as in Case 10 (Figs. 1, 2 and 3). The skin of the palm cannot readily be mobilized; hence excision of an appreciable amount of scar tissue leaves defects that must be repaired by skin and fat from other parts of the body. This is best accomplished by transplantation of a section of skin, fat and superficial fascia from the abdominal wall by means of the method described by Babcock as illustrated in Figures 4 and 5. The area of scar tissue is completely excised in order that the blood supply between the flap and bed may be readily established. A flap of skin, superficial fascia, and fat is dissected free from the abdominal wall, except for the pedicular attachment, which should if possible be the superior portion of the flap. Great care should be taken to make the flap fit the bed accurately. It is then sutured along the free border to the skin margins of the bed, care being exercised not to constrict the pedicle of the transplant. The hand is then put up in a comfortable dressing for a period of about nine days. During this time the abdominal flap will acquire sufficient blood supply to allow the pedicle to be severed. In all probability the union between the sutured flap and the skin margin will be complete; but it may be possible that one of the corners of the transplant will show signs of necrosis, and a definite line of demarcation may be present. In case this has occurred, the necrotic area may be trimmed away and the vascular edge of the transplant approximated to the skin margin, usually resulting in prompt union. By this means a serviceable skin surface is provided in place of a tender cicatrix, and a suitable bed is secured for the tendons.

TENDON INJURIES

Few of the projectiles passed completely through the hand, and as a result the greater number of these cases were injuries only of the extensor tendons. In twenty-five cases the extensor tendons were involved, and in three cases only the flexor tendons; in four cases both flexor and extensor tendons had been subjected to injury. In the last group, the damage was done by a projectile entering on the dorsal surface of the hand and passing out through the palm.

Three distinct types of cases with tendon involvement may be described, namely, complete division, partial division and adherent tendons.

Complete Division.—When complete division had taken place, it was not uncommon to find the severed ends embedded deeply in callous or scar tissue in the

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*Because of lack of space, this article is abbreviated by the omission of many case reports. The complete article will appear in the reprints, a copy of which may be obtained on application to the authors.

hand in a plane corresponding to the course of the projectile. By careful dissection the tendon could be freed and often exhibited very little destruction, a fact that proved of great value in considering the repair.

Partial Division.—In the small number of cases in which the tendons were partially divided, an over-

Fig. 1 (Case 10).—Perforating gunshot wound of the hand with large cicatrix in the palm. The flexor tendons of the thumb and the first two fingers have been divided. Note the adduction deformity of the thumb.

production of fibrous tissue along the remnants of the tendon sheath and beneath the skin prevented return of function. Prior to operation it was impossible to differentiate this group.

Adherent Tendons.—Tendon adhesions were due to lacerated wounds in the long axis of the hand, followed by infection. The differentiation between this type of case and complete division presented no great difficulty for the reason that attempted active extension of the digits showed distinct evidence of force being transmitted along the tendon course.

For the sake of classification, these three groups have been described in detail; but one must bear in mind the fact that rarely was a single one of these conditions present at one time.

Treatment of Tendon Injuries.—That a moderate range of joint motion must precede tendon function is an axiom well worth remembering. It is useless to expect a repaired or liberated tendon to combat an

Fig. 2 (Case 10).—Cicatrix has been excised, tendons repaired, and transplant is in place. Skin edges are not entirely healed.

ankylosed joint; therefore in describing the treatment of tendon injuries we shall assume the range of motion of the joints of the hand to be moderately free.

Complete Division.—When tendon division had taken place, tendon repair or tendon transplantation was, of course, considered. By careful dissection it

was possible at times to separate enough of the tendon from the cicatricial tissue to allow end to end repair. When such gaps were present that end to end repair was impossible, the extensor indicis and extensor minimi digiti were available for transplantation as extensors to any of the digits except the first. The tendon of the extensor carpi radialis brevis may be transplanted into the distal tendinous portion of the extensor ossis metacarpi pollicis or extensors longus or brevis pollicis, as in Case 38. In case of ankylosis of the wrist, the extensors carpi radialis longior and brevis, the extensor carpi ulnaris, and the flexors carpi radialis and ulnaris may be utilized.

Partial Division.—When partial division had taken place, the rational procedure was followed. The tendons were liberated from the bed of scar tissue and the divided portion sutured. In many cases of complete or partial division, adjacent tendons were found to be bound down to the metacarpals or the interossei by dense scar tissue.

Adherent Tendons.—The problem of tendon adhesions was met by tendon liberation and early active motion, which should be understood to be due to active contraction of muscles which will produce motion of the affected tendons, or by tendon liberation and an

Fig. 3 (Case 10).—Five weeks after operation. Transplant of skin fat and fascia healed. Note the abduction of the thumb.

autogenous fat and fascia transplant. Fat and fascia were transplanted in eight cases, infection following in one case within forty-eight hours. In four cases, the skin remained healed for fourteen days, when the skin margins separated slightly, liberating a considerable amount of oily fluid, the result of fat decomposition. In two cases, the wounds healed promptly after the discharge, and in the two remaining, infection followed and the transplants were extruded, leading of course to absolute failure. In three cases, satisfactory return of tendon function followed. If a fat and fascia transplant is used, the difficulties of skin closure are multiplied several fold. In view of the skin defects that were dealt with, it is possible that conclusions should not be drawn from these cases. However, the fact remains that the best results were obtained without fat and fascia transplants, in cases in which early active motion was instituted, often within a few hours after operation.

FRACTURES OF THE CARPUS

Fractures of the carpus are considered only so far as they are factors in determining the relationship of the hand to the forearm. In several instances, fractures of the scaphoid and semilunar bones with dis-

placement of the proximal fragment were found to limit dorsal flexion by mechanical blocking, and as a result the muscle balance of the hand was destroyed (Cases 7 and 12). This lesion was only a component part of the picture, but necessitated consideration before perfect functional restoration could be gained. Even though a considerable range of motion was present in an arc of palmar flexion, measures to bring the hand into a position of dorsal flexion with somewhat of a sacrifice, if necessary, of the arc of motion seemed advisable for the sake of restoration of the normal muscle balance.

When the carpal bones had been extensively destroyed, radial deflection of the hand was found to occur in conjunction with palmar flexion. The articular surfaces of the radius and ulna were often destroyed by the injury or the associated infection. Motion in the position of deformity was painful, and the deformities showed great tendency to recur after correction by mechanical measures.

The best results were obtained by carporadio-ulnar resection of bone, sufficient to allow correction of the deviation of the hand and to allow the hand to be set at an angle of 40 degrees of dorsal flexion, with fixation in this position until firm bony ankylosis had occurred, care being taken to preserve tendon and joint function during this period.

Fig. 4 (schematic).—Single pedicle abdominal flap in position, vascularized and ready to be cut free.

Fig. 5 (schematic).—Flap liberated with method of abdominal skin closure. Incisions along dotted lines allow skin margins to be approximated.

FRACTURES OF THE METACARPAL BONES

Fractures of the metacarpal bones calling for special consideration by the orthopedic surgeon are of two varieties: those with nonunion, and those with union in such a position as to disturb the alinement of their respective joint surfaces.

Nonunion is rarely seen when approximation of the fragments has occurred. The lack of union is generally found to be due to defects in the shafts, and may be associated with destruction of either of the articulating extremities.

The loss of proximal metacarpal fixation is a troublesome factor, especially if associated with ankylosis of the metacarpophalangeal joints, because of the false point of motion. An attempt to secure proximal metacarpal fixation is advisable, either by implantation of the metacarpal shafts into the carpus, or, if the defect is too great, by means of an autogenous bone transplant that will bridge the gap between the metacarpal and the carpus in juxtaposition. This having been accomplished, the proximal arm of the lever becomes fixed, and the problem of restoration of motion in the metacarpophalangeal joint may be attacked.

Ununited fractures of the metacarpal bones disturb the function of the metacarpophalangeal joints because

the proximal end of the distal fragment becomes tilted forward, throwing the articulating surface backward, changing the arc of flexion, and destroying the muscle balance of the finger in question. At operation the fragments may be properly approximated and the defect in the shaft repaired by a carefully cut tibial

Fig. 6 (Case 16).—Amputation of four fingers through distal part of metacarpal shafts, unhealed; greatest tenderness over the only available point of apposition for the thumb.

transplant or by exogenous bone. In two cases of repair by autogenous bone, the results were most gratifying, while exogenous bone (beef) was used in one case with an unsatisfactory result.

Destruction of the distal metacarpal articulating surfaces presents greater difficulties. The management of this condition depends on the number of

Fig. 7 (Case 16).—Appearance of hand two months after operation. Unhealed cicatrix has been excised, and skin fat and fascia transplant from the abdominal wall has healed, resulting in a good functional result. A prosthesis was readily fitted to this stump to be worn for esthetic effect when desired.

fingers involved; and if only one, the extent of the process will determine the treatment. A point of

approximation for the thumb should be preserved, and if need be, an ankylosed metacarpophalangeal joint may be considered to obtain this end. Should the

Fig. 8 (Case 24).—Amputation of index finger; flail third finger due to resection of metacarpal with extensive scar tissue formation following gunshot wound.

function of the remaining digits be undisturbed and one metacarpal be extensively involved, amputation of the digit with resection of the fragments of the metacarpal shaft will give the best result, as in Case 24.

Fractures of the metacarpal bones with union in malposition do not require special remark except that the normal relationship of the joint surfaces must be secured to insure the return of greatest function. This realignment is easily accomplished after an osteotomy at the point of election.

JOINT INVOLVEMENT

Of primary importance in reconstructive surgery of the hand is the condition of the joints; for regardless of how ingenious or how skilfully executed, an operation on tendons, failure to secure a good functional result will be certain if there is marked limitation of motion or ankylosis of the joints to be functionated. Muscular contraction is a means of

Fig. 9 (Case 24).—Appearance of hand two months after operation. Scar was excised, defect in the third metacarpal repaired by transposing the remains of the shaft of the second metacarpal and finger fixed in position of slight palmar flexion to allow approximation of the thumb. This procedure was imperative to secure a point of approximation for the thumb because of ankylosis of the fourth and fifth metacarpophalangeal joints.

producing joint motion; and if there is not already passive motion in a joint, it is a waste of time and energy, both to the patient and the surgeon, to per-

form a tendon operation and then expect a result. In those cases in which ankylosis or limitation of motion is expected, there are positions of election to secure the maximum degree of usefulness.

Limitation of motion in a joint may be due to extra-articular causes, usually when associated with gunshot wounds with infection, to a thickened contracted capsule, or to intra-articular causes, usually a fracture extending into the joint, or to destruction of the articular cartilage.

All injuries of the wrist joint should be treated with the wrist in a position of dorsal flexion, particularly when there is any likelihood of a resulting limitation of motion or complete ankylosis. If the wrist is in a position of palmar flexion or in a neutral position, the force of the grip is diminished because of the loss of muscle balance. The position of dorsal flexion is the position of strength. To secure this position, it is necessary to devote special attention to the splinting. Any of the ordinary cock-up splints will usually suffice if properly applied and observed. If the tendon injury is uncomplicated by joint involvement, the mere passive attitude of the hand in palmar flexion will result in a deformity that may require months of treatment to restore function.

In practically all cases of injury to the tendons of the fingers there has been a marked limitation of motion of the metacarpophalangeal joints, and the

Fig. 10 (Case 23).—Persistent hyperextension of metacarpophalangeal joint as a result of excision of scar and a posterior capsulorrhaphy.

fingers were as a rule found in a position of hyperextension. This deformity was associated with thickening and contraction of the joint capsule. Baking, massage, contrast baths and other physiotherapeutic measures commonly used seemed of very little benefit without elastic traction. A very satisfactory apparatus may be improvised such as is shown in Figures 15 and 16. The rubber tubing is attached to the fingers by adhesive plaster and then attached to heavy iron wire embedded in a molded plaster-of-Paris palmar splint that will extend to the elbow. The traction must first be made in the line of deformity. By bending the wire, the deformity can gradually be overcome and flexion of the fingers produced. In conjunction with this traction and flexion, it is important that daily massage and manipulation be given with the splint removed, with the exception of the adhesive bands attached to the fingers. Good results have been obtained more rapidly by a transverse posterior capsulorrhaphy at the time of the tendon repair. The fibrous capsule of the metacarpophalangeal joint is incised transversely, allowing the maximum of palmar flexion at this joint immediately. Massage and exercise must be used faithfully after this operation to obtain the best results.

One case of recurrent dislocation of the first carpometacarpal joint was observed in this series of cases. This was due to impacted fractures of both the trapezium and trapezoid bones of the wrist which altered

the plane of the articulating surface of the trapezium. The joint was partially stabilized by passing a heavy silk ligature through the base of the first metacarpal, and thence through the body of the trapezium. This ligature was tied with the thumb in a position of extreme extension. The result seemed most satisfactory, for at the end of four weeks the patient had recovered complete function of the first digit and had suffered no relapse at the time of departure from the hospital, several weeks later.

The limitation of motion in the interphalangeal joints caused comparatively little difficulty, as these conditions were readily amenable to physiotherapeutic measures.

AMPUTATIONS

Evidences of conservation of the structures of the hand are seen constantly. Thanks to the able surgery performed at the front, metacarpal stumps that might be of value as apposing digits have been preserved. It must be borne in mind that a functioning thumb with a point of apposition will make a useful hand, and that the artificial hand with all of the delicate mechanism has never been perfected to the degree of

Fig. 11 (Case 23).—Limit of voluntary flexion of the finger ten days after dorsal transverse incision of the capsule of the metacarpophalangeal joint.

usefulness equal to that of apposing digits or parts of digits.

In case all fingers are amputated, the point of apposition, which will necessarily be metacarpal stumps, must be covered with integument that is not sensitive. Unfortunately, laceration of soft parts is more extensive than the resection of bone, resulting in the formation of cicatricial tissue over the osseous structures. Scar tissue is prone to crack and become abraded with the slightest trauma. This cicatricial tissue may be replaced with skin and fat by resection of the entire scar and transplantation of a pedicle of fat and fascia, after the technic illustrated in Figures 4 and 5 with the result shown in Figure 7. In this particular instance the result was most pleasing, because a tender unhealed stump of a hand was transformed into a functioning member.

The question of finger amputation is open to considerable controversy; but it seems to be agreed that in case both flexor and extensor tendons of one digit, excepting the first, are involved, amputation should be considered. Metacarpal and metacarpophalangeal joint injury with tendon involvement of only one

digit, except the first, should always be treated by amputation of the digit. Metacarpal shaft destruction which may occur without tendon injury does not

Fig. 12 (Case 21).—Ankylosis of the wrist joint in a position of palmar flexion with marked disturbance of muscle balance of the flexors and extensors of the fingers and partial ankylosis of all of the small joints of the hand. This condition was not amenable to mechanical treatment.

require amputation of the digit if the distal articular surface of the metacarpal is uninvolved.

TIME OF OPERATION

The time of operation in the cases reported was earlier than has been customary. Rarely was any plastic work attempted before the wounds had been healed two months. After this period had elapsed, the area of injury was subjected to intensive mechanical irritation; and if no reaction appeared in the skin or subcutaneous tissues, pain and tenderness being absent, it was felt that the problem might be attacked surgically with impunity.

A few infections occurred, but the percentage was so low that early operation is to be encouraged in order that the soldier may be restored to usefulness as soon as possible.

CASE 10.—A soldier, admitted, Dec. 26, 1918, had received a perforating gunshot wound of the palm of the hand, Oct. 27, 1918. Infection followed immediately. On admission a large irregular scar was present in the palm with a contracture

Fig. 13 (Case 21).—Eight weeks after fixation of hand in a position of dorsal flexion, with rapid return of function of the digits under therapeutic measures that were unavailing before the correction of the palmar flexion deformity.

causing an adduction deformity of the thumb and flexion of the index and middle fingers. The flexor longus pollicis tendon and the tendons of the flexors profundus and sublimus digitorum to the index and middle fingers were divided. There was a distal articular fracture of the third metacarpal. Operation, March 22, 1919, after wounds had been healed

eight weeks. The flexor tendons to the thumb, index and middle fingers were repaired and the entire mass of scar tissue excised. A transplant of skin, fascia and fat was transplanted into the palm by the two stage method. The flap was cut loose ten days later. At present, five weeks

Fig. 14 (Case 28).—Roentgenogram taken five weeks after repair of metacarpal defects by autogenous bone transplants.

following operation, the skin transplant is healed and there is distinct flexion power in the thumb, index and middle fingers. Repair of the extensor tendons is to be done later.

CASE 16.—A soldier received a machine gun bullet wound of the right hand, July 28, 1918, resulting in amputation of the four fingers at the metacarpophalangeal joints. There was normal motion in the thumb but there was difficulty in apposing it to the stump, which was covered by a tender granulating surface with surrounding skin poorly nourished. Operation, Dec. 5, 1918, when the entire scar over the end of the stump was excised and a thick double pedicle skin flap from the abdomen was sutured in place. The flap was cut loose nine days later and the skin of the flap was sutured to the hand. The skin flap was entirely healed three weeks after operation; on the patient's discharge, two months later, there was a narrow linear scar encircling the transplant with a good tough pad, to which he could appose the thumb.

CASE 21.—March 15, 1918, a soldier accidentally cut himself with a knife on the left palm. Infection followed which was treated by multiple dorsal incisions. When admitted, July 23, 1918, there was a bony ankylosis of the wrist in extreme palmar flexion, with ulnar deflection, and no motion in the metacarpophalangeal joints. Massage, manipulations under ether, and plaster-of-Paris wedging were tried with no improvement. Operation, Feb. 6, 1919, when wounds had been healed six months. A wedge of bone was removed from the lower end of the radius, scaphoid, and semilunar to allow the hand to be brought up into dorsal flexion. The wound healed by first intention and at present, ten weeks after operation, the wrist is in a position of 30 degrees dorsal flexion, and there is no ulnar deflection. There is also marked improvement in the range of motion of the fingers, each of which can be apposed by the thumb.

CASE 23.—A soldier, admitted, Oct. 25, 1918, had been wounded, July 18, 1918, by a fragment of a shell. The thumb and first finger were amputated leaving the proximal half of the second metacarpal bone. On admission the wound was not healed. Nov. 29, 1918, the remaining part of the second metacarpal bone was removed. The wound healed, Feb. 1, 1919. Motion was limited in all of the joints of the remaining fingers. March 10, 1919, the scar was excised and manipulation allowed free motion in all of the joints except that of the third metacarpophalangeal joint. A posterior capsulorrhaphy was done at this joint allowing free motion. Five days following operation, active motion was possible at these joints. The wound healed by first intention and at present, seven weeks after operation, the patient can flex the metacarpophalangeal joint 60 degrees and he has good motion in the interphalangeal joints.

CASE 24.—A soldier received a perforating gunshot wound of the right hand, July 15, 1918. On admission the wound was healed. The index finger with the distal end of the second metacarpal was amputated, and there was an ununited fracture of the shaft of the third metacarpal with a flail middle finger. Operation, Jan. 15, 1918, when the wound had been healed four months. The scar was excised and the shaft of the second metacarpal was transplanted between the remaining ends of the third metacarpal. The divided extensor tendon to the middle finger was sutured. One week after operation there was a separation of the skin edges of the wound. The wound healed in two months with ankylosis of the metacarpophalangeal joint, but the whole middle finger, which was abducted, was a decidedly useful member. There was good union in the fractured third metacarpal.

CASE 28.—A soldier, admitted, Feb. 19, 1919, had received a perforating gunshot wound of the left hand, Oct. 1, 1918. The wound became septic and drained about one month. On admission he showed a small healed scar on the palm and a large stellate scar on the dorsum of the hand. There was laceration of the extensor tendon to the ring finger. The extensor tendons to the middle and little fingers were bound down in scar tissue resulting in complete loss of function of the middle and ring fingers. There was only slight power of extension in the little finger. There was also a comminuted fracture, ununited, of the shaft of the third and fourth metacarpals, with marked overriding. Operation, March 22, 1919, when the wound had been healed ten weeks. The tendons of the middle and little finger were liberated from the scar and the extensor indicis tendon was transplanted into the distal end of the extensor tendon of the ring finger. Bone grafts, 4 cm. long, from the left tibia were transplanted between the fractured ends of the third and

Fig. 15.—Front view of efficient elastic traction splint used to obtain flexion of the small joints of the hand, first suggested to us by Major M. S. Danforth, M. C., Providence, R. I.

fourth metacarpals. The wound healed by first intention, and at present, five weeks after operation, there is good union in the fractured metacarpals and almost complete power of flexion in the middle and ring fingers.

CASE 38.—A soldier received a gunshot wound of the right forearm, Nov. 1, 1918, which divided the belly of the extensor

communis digitorum muscle and destroyed the nerve supply of the extensor longus and brevis pollicis, resulting in loss of power of extension of the thumb and third and fourth fingers. The wound healed four weeks after injury. Operation, April 9, 1919, four months after wound had healed,

Fig. 16.—Side view of elastic traction splint.

when the muscle belly of the extensor communis digitorum was repaired and the extensor carpi radialis brevis was freed at its insertion and transplanted into the distal tendinous portion of the extensor longus pollicis. Eight weeks after operation, the soldier had almost complete return of extension in the thumb, third and fourth fingers.

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THE GASTRIC HYPERMOTILITY ASSOCIATED WITH DISEASES OF THE GALLBLADDER, DUODENUM, AND APPENDIX

A CLINICAL AND EXPERIMENTAL STUDY *

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The stomach in a general way is recognized by the diagnostician as the spokesman for disease anywhere within the abdominal cavity, but particularly for organic disturbances of the gallbladder, duodenum and appendix. It is not only very difficult to ascertain which of these three organs is afflicted, but it is often impossible to free the stomach entirely from suspicion of disease. It becomes, therefore, of the utmost importance to the abdominal surgeon to have some system of classifying gastric motor pictures by which a pathologic condition of the stomach is established or eliminated, so that he may determine what organ is pathologic if the stomach is normal, and to what extent the diseased organ is involved.

There are obviously two means of studying the reflex activity of the stomach: the review of recent hospital records, and the duplication, as far as possible, of the human disease equations in the experimental laboratory. The reports of gallbladder, duodenum, and

appendix cases in the Third Division, Bellevue Hospital, from 1911 to the present time, have been reviewed, and from these have been selected only those cases with full roentgenographic reports based on complete gastro-intestinal examination confirmed or modified by direct inspection of the open abdomen. In those few instances in which the roentgenographic diagnosis did not correspond to the actual findings at operation, the error, which was one of inference and not of observation, was corrected. For example, a persistent irregularity in the outline of the stomach has been called organic and, at operation, the stomach appears absolutely normal; this same stomach is known to functionate normally in terms of emptying and of secreting; it is obvious that the "irregularity" described as organic may be either organic or inorganic; and, on the foregoing basis, the roentgenographic description is changed from "probable adhesion" or "scirrhous involvement" to gastropasm. The pathologic findings have been purposely omitted; their significance, as far as the stomach function is concerned, may be the measure of the stimulation or depression of the stomach.

From these surveys, it appears that the percentages of hypermotility, hypomotility and normal gastric function in gallbladder disease (meaning cholecystitis with or without cholelithiasis) are: hypermotility, 68.4; hypomotility, 0; normal, 31.6; in diseased duodenums (duodenal ulcers): hypermotility, 75; hypomotility,

Fig. 1.—Diffuse pylorospasm secondary to postappendiceal obstruction. There was no bismuth to be seen beyond the obstruction in the pylorus. The bowel was wholly free from bismuth.

12.5; normal, 12.5; and in "chronic appendicitis": hypermotility, 55; hypomotility, 0; normal, 45.

There are in this, as in any similar review of case statistics, many sources of error. A few of these are: the general condition of the patient; the emotional state of the patient at the time of the roentgen-ray examina-

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