

around the screws causes them to loosen, with consequent shifting of the plate. Those plates that remain *in situ* for several years are merely exceptions to the rule. It is most illogical to put metal into bone, and he foresaw that Dr. Albee's bonegraft inlay and peg methods had sounded the knell of all metal fixtures.

Continuing the comparison between bone and soft tissues, take, for example, a nerve that has been divided for some time. There are bulbs of scar-tissue at the ends. The ends are perfectly contacted, but one never gets union. Why? Because the nerve-fibres cannot penetrate the barrier of scar-tissue. When, on the other hand, the bulbous scarred ends are removed until the brush-like ends of the fibrillæ stand out, and the freshened ends are *accurately* contacted, regeneration occurs, and the nerve resumes its property of conduction. The same state of affairs is met with in an old, ununited fracture. The ends of the fragments are sclerosed (scar-tissue), and with the plate we get contact without union, for the same reason, unless the ends be resected. By the bonegraft inlay method of Albee, on the other hand, healthy bone spans the sclerosed area, and assures union by its osteogenetic, as well as osteoconductive, properties.

DR. ALBEE, in closing, said that he had seen silver wire break in several instances in fracture of the patella, in one case coming through the skin. Silver wire in ununited fractures is most untrustworthy. Fixation is a secondary consideration. Something is required to span the sclerosed bone and complete the contact with healthy bone beyond the point of fracture, something that will not only supply bone callus but that will stimulate osteogenesis, and this the bone graft does. He was equally certain that in relatively large grafts a varying part of the central portion acts as a scaffold for migrating bone-cells from the fragments. The reconstruction of the graft is a physiological affair. Regarding extrusion of the graft, there was one case where the graft was applied to the jaw, and the wound connected with the oral cavity, in which practically all the graft came out. In only two in 400 cases has the whole graft been extruded. He had had in several cases little slivers come out. The whole graft has been laid bare by an infected wound and has become covered up with granulations; perhaps little shells have come off, but the graft has served its purpose. It is a most trustworthy surgical agent and of an entirely different class from metal. It has a definite resistance to infection. He had had no experience in the use of the graft in jaw fractures. Some of his cases of fracture of the neck of the femur had been of long duration (*i.e.*, up to two and one-half years).

STATED MEETING, APRIL 5, 1915

The President, DR. JOHN H. GIBBON, in the Chair

GYNÆCOMASTIA

DR. NATHANIEL GINSBURG presented a man, nineteen years of age, in whom for six months the left breast has slowly and steadily increased in size without evidence of pain, and at present presents the appearance of a young female breast about puberty or a little later (Fig. 1). There is prominence of the nipple and distinct mammary tissue hypertrophy, with an areola of pigmentation about the nipple which is more marked than present on the right side. There is no record of antecedent injury, unless his occupation (a shoemaker) has predisposed him to occupational traumatism to this region. The breast tumor is a diffuse, somewhat circumscribed, enlargement, corresponding anatomically to the normal young adult breast outlines. There is no fixation or retraction of the nipple. There is no mammary secretion and no enlargement of the axillary lymph-nodes. Dr. John Speese (ANNALS OF SURGERY, April, 1912) regards this type of benign tumor in the young male breast as an adenofibroma and I am in agreement with his views, believing this case will histologically conform to that type of tumor. I do not believe this case in its inception could have been termed "Adolescent Mastitis" unless this is synonymous with adenofibroma.

DR. JOHN H. GIBBON (Transactions of the Philadelphia Academy of Surgery, April, 1912) reported the case of a young man twenty-one years of age, also a shoemaker, upon whom he had operated; and examination of whose tumor showed it to be an adenofibroma of the breast.

This is an unusual and rare breast tumor in the male, and since it is steadily increasing in size, with a view of removing the malignant potentiality present, I have advised and shall perform a plastic resection with preservation of the nipple.

Note.—Plastic resection of the breast and histological examination showed the breast enlargement to be a case of gynæcomastia.

DR. PENN G. SKILLERN, JR., disagreed with Dr. Ginsburg in his diagnosis of neoplasm, and regarded it as a case of unilateral gynæcomastia, or physiological metamorphosis of the male breast into the

female type, of which there are now about one hundred and ten cases on record. In support of this view, he related the history of the following case, which was seen by him in the Surgical Out-patient Department of the University Hospital (Case-record 39964), March 4, 1914, and reported, together with a photograph, in *International Clinics*, 1914, 24th series, vol. ii, p. 238.

A white male, aged nineteen years, single, student, stated that for the past two years he has noticed a gradual enlargement of the left breast, and that as the result of conversation with some medical students he feared he was getting a cancer. Examination revealed no neoplasm, but a well-developed left breast, corresponding to that of a sixteen-year-old girl. The right breast, the genitalia, and the sexual instincts were wholly masculine. Chiefly for cosmetic reasons, but also to anticipate the malignant degenerations to which anomalous structures are notoriously liable, a plastic operation was performed a year later.

Gynæcomastia may be bilateral or unilateral, and when one breast alone is involved, it is more often the left. Many cases are associated with anomalies of other portions of the reproductive apparatus, such as hypospadias, absence of pubic hair, etc. At times there is a familial predisposition. It might be expected that such an anomaly would show degenerative changes, such as increase in the amount of fibrous tissue, and atypical architecture of the mammary tissue itself. These changes, however, must be considered as part and parcel of this condition, and, *per se*, do not justify the microscopical diagnosis of neoplasm. A tumor could hardly make a male breast mimic so perfectly a female.

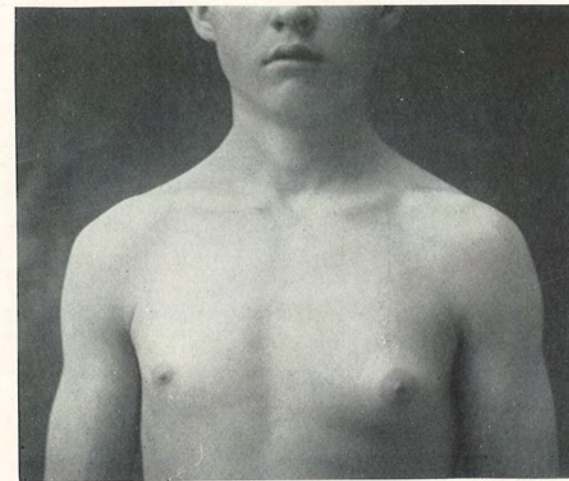


FIG. 1.—Hypertrophy of breast in a young adult male.

ON FRACTURES OF THE SESAMOID BONES OF THE THUMB*

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THE following case represents the fourth example of fracture of a sesamoid bone of the thumb to be recorded in the literature.

E. B., male, white, aged twenty-six years, civil engineer, reported at the Surgical Out-patient Department of the University Hospital (Case record 61996) on March 2, 1915, with the history of having fallen three days previously in such manner that the left thumb was traumatized against the granite Belgian block pavement.

This hand had never been injured previously. Clinical examination revealed moderate swelling of the left thumb, ecchymosis along the thenar eminence, and "wincing" tenderness both at the head and at the base of the first metacarpal. A clinical diagnosis was made of a "chipping" fracture of the metacarpal head. Skiagram (Fig. 1) revealed a fracture of the ulnar sesamoid bone opposite the head of the first metacarpal, the smaller fragment being separated distally, and there being a definite, dentate line of fracture. There was also an oblique fracture at the base of the metacarpal, separating the ulnar corner and entering the carpo-metacarpal joint at its middle. The thumb was immobilized in extension and slight abduction by a spica sodium silicate bandage.

Re-examination after the reading of the skiagram brought out two additional facts. In the first instance, the patient was loose-jointed, and could hyperextend both thumbs normally at the metacarpo-phalangeal joint. In the second place, there was definite "wincing" tenderness, localized to the ulnar sesamoid bone. After four weeks the immobilizing dressing was removed, and massage instituted.

While the clinical diagnosis of "chipping" fracture of the metacarpal head was inaccurate, yet it was close enough to lead to the detection of the fracture of the sesamoid bone. In order to parry the question of a congenitally bipartite sesamoid, a skiagram of the right thumb was taken (Fig. 2), but no abnormality of the sesamoids was revealed. This fact, together with the history of a fall upon the thumb, the clinical localization of "wincing" tenderness to the sesamoid, shown

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

involved by the skiagram, and the dentate line of the fragments in the skiagram contrasted with the smooth line of a bipartite sesamoid, points to a fracture.

The other three cases were found only in the German literature.

The first case was reported by Preiser, in 1907 (*Aerzt. Sachverstaendigenzeitung*, 1907, No. 19, S. 400). The patient was a woman, aged thirty years, who had fallen upon the right hand, fracturing both of the sesamoids of the thumb.

The second case was observed by Morian, in 1905, but not reported until two years later, nor published until 1909 (*Deutsch. Zeitschr. f. Chirurg.*, 1909, H. 102, S. 394). The patient was a man, aged twenty-seven years, whose right thumb was caught between a closing door and the jamb. Skiagram revealed a comminuted fracture of the ulnar sesamoid bone.

The third case was presented by Maas, in 1912, in an inaugural dissertation entitled: "Ueber Sesambein-Frakturen" (*Emil Ebering*, Berlin, 1912, 18pp.), which reviews the subject and gives references to the literature, and which is the latest article that could be found at the time of preparation of this paper. The patient was a man, aged fifty-three years, a wheelwright by trade, who was struck upon the left thumb by the end of an unfinished metal tire. The skiagram Maas shows reveals a fracture very similar to that in my case, and involving the ulnar sesamoid bone. In this case the tire was grasped between the thumb and the index finger, resting upon the ulnar sesamoid bone, which was thus directly exposed to trauma. Skiagram of the right hand showed a normal state of the bones.

As to the nature of the violence that produced the injury, whether direct or indirect, it is difficult to decide, for the mechanism of the fall was such that the one could operate as well as the other, and arguments could be brought forth in favor of either form. The absence of comminution of the fragments, and their similarity in the skiagram to fractures produced experimentally by indirect violence, however, lead one to conclude that the latter variety of violence was effective. The three previously reported cases, on the contrary, were due to *direct* violence. But Morian criticises Preiser for rejecting indirect violence as the cause of the fracture in his patient, who, like mine, also fell upon her outstretched thumb.

Experimentally, fractures have been produced by both forms of violence. Preiser obtained results by direct violence, but could produce none by indirect violence. Morian found it easy to procure fractures by direct force, and then made eight attempts to secure fracture by indirect force, in five of which he succeeded. Of these five, in four both bones were broken (compare Preiser's case), while in the fifth the ulnar alone was involved. In all, the line of fracture was transverse or oblique, and a small fragment was separated as often proximally as



FIG. 1.—Fracture of ulnar sesamoid bone of thumb. Fracture of base of first metacarpal bone.

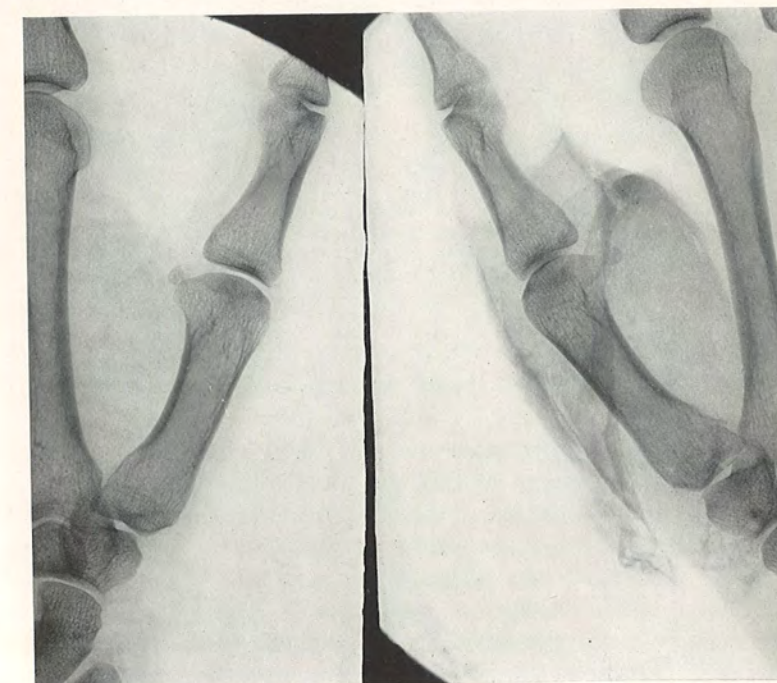


FIG. 2.—Same as Fig. 1. The normal right thumb is shown for comparison.

distally with one exception, a radial sesamoid that was broken through the middle. Clinically, fractures by indirect violence, as obtains in fractures of the patella from a similar cause, are associated with more extensive laceration of the capsule of the joint.

In an attempt to clarify the subject I examined 22 thumbs in the Anatomical Laboratory, some of the results of which are shown in the cuts (Figs. 3 to 9). The first sketch (Fig. 3) shows the normal sesamoids *in situ*. The radial is typically larger and oval, and the ulnar smaller and round, and situated more distally. Both rest upon, or close to, the anterior border of the base of the proximal phalanx.

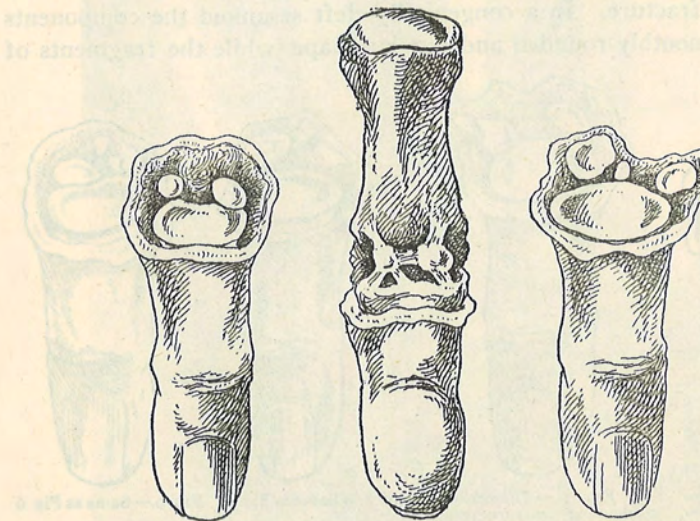


FIG. 3.—Dissection showing normal sesamoids of thumb *in situ*. Radial is large and oval; ulnar is small and round.

FIG. 4.—Dissection showing ligaments connected with sesamoids. One intersesamoid; two radial; three ulnar.

FIG. 5.—Dissection showing bipartite radial sesamoid. Note smooth, even edge.

Both are embedded in the capsule, receive insertions of muscles from the thenar eminence, and form a groove through which passes the long flexor tendon.

The second sketch (Fig. 4) demonstrates what I have been unable to find any description of, namely, definite ligaments connected with the sesamoids, aside from that which binds the two bones together. In this specimen five definite capsular thickenings were found, of which two were associated with the radial, and three with the ulnar, sesamoid. These recall in miniature the picture of the patella with its quadriceps tendon and ligamentum patellæ, and the effect of sudden, forcible hyperextension upon the sesamoids seated upon the border of

the phalanx is fairly comparable with the patella resting upon the trochlea of the femur when subjected to similar strain. Instead of the ligament itself tearing it avulses a shell of bone, as in any other tear fracture.

The third sketch (Fig. 5) shows a congenital division of the radial sesamoid: a similar condition of the same bone was also found by Preiser in his experimental investigations. Morian saw clinically a like state of the ulnar sesamoid in a patient whose daughter had a congenitally-cleft sesamoid of the great toe. But for the following points of differentiation, as emphasized by Stumme, one might be deceived by diagnosing fracture. In a congenitally-cleft sesamoid the components possess a smoothly-rounded and regular shape, while the fragments of

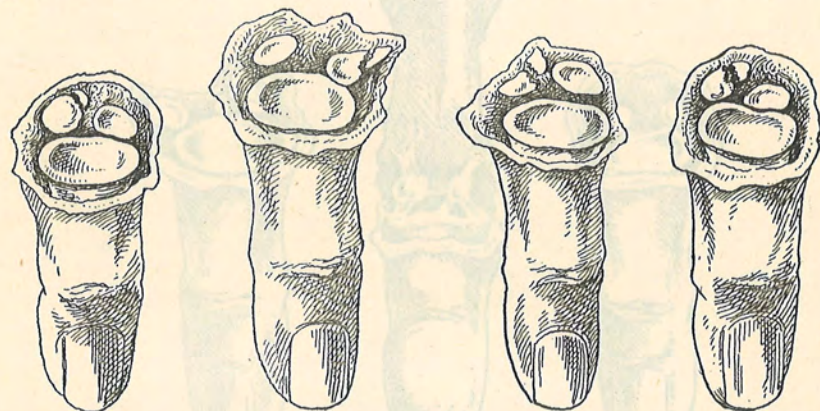


FIG. 6.—Dissection showing tear-fracture of ulnar sesamoid experimentally produced.

FIG. 7.—Dissection showing tear-fracture of radial sesamoid experimentally produced.

FIG. 8.—Same as Fig. 6.

FIG. 9.—Same as Fig. 6.

a broken sesamoid show an irregular, dentate edge on the side that corresponds to the line of fracture.

The remaining sketches (Figs. 6, 7, 8 and 9) show a series of tear-fractures. Each specimen was prepared as follows: The thumb was disarticulated at its junction with the carpus. The muscles were removed without disturbing the joints. The metacarpal bone was fixed in a vise, and with a wooden mallet a blow was struck upon the front of the thumb near its tip. Not always did the sesamoid fracture, however. In some cases the phalanx, in others the metacarpal broke into or near the joint. But of the breaks obtained the four shown are fairly typical of what one might expect in the living. In these four cases the ulnar sesamoid yielded three times (Figs. 6, 8 and 9) and the radial once (Fig. 7). In no instance were both sesamoids broken.



FIG. 10.—Hand showing a complete set of ten sesamoids opposite the metacarpal heads. An additional sesamoid is seen opposite the head of the proximal phalanx of the thumb.

The removal of the muscles showed that they play no part in the fracture.

Failure to detect a fractured sesamoid might be regarded as an inconsequential matter, but it must be remembered that the thumb is a very highly-specialized digit, capable of delicate and intricate movements, and that its crippling might be an affair of serious moment to a wage-earner.

The treatment is by immobilization in a neutral position, and for this purpose a sodium silicate dressing, left undisturbed for four weeks, fulfils all indications. It must not be forgotten that the sesamoid, like the scaphoid, is bathed by synovial fluid, and therefore heals slowly.

As to the remaining fingers, the sesamoid bones are inconstant. Citing Pfitzner, Dwight (*Variations in the Bones of the Hands and Feet*; Philadelphia, J. B. Lippincott Company, 1907, p. 11) tabulates the findings in 1440 adult hands as follows:

	I	II	III	IV	V
R.....	99.9	48.7	1.4	0	2.1
U.....	100	0.1	0	0.1	82.5

In his thesis, Maas evidently overlooked this table of Pfitzner's, for he states that the radial sesamoid of the middle finger has never been observed. According to the table, the ulnar sesamoid of the middle finger and the radial sesamoid of the ring finger were not found. I chanced upon a skiagram that shows the complete set of ten, and an additional sesamoid opposite the distal interphalangeal joint of the thumb (Fig. 10). Pfitzner has observed congenital division of the ulnar sesamoid of the little finger, as well as of the radial sesamoid of the index. I have found no instance of fracture of the sesamoid bones of the fingers, but it is quite probable that examples will be reported in the future.

DIPHThERIAL AND PSEUDODIPHThERIAL PRIMARY CUTANEous INFECTION*

By ARThUR E. BILLINGS, M.D.
OF PHILADELPHIA, PA.

WE find, after a rather careful review of the literature, that primary cutaneous diphtheria, unassociated with infection of the mucous membrane by the Klebs-Löffler bacillus, is an unusual condition. I also am unable to find any report of case or cases of primary cutaneous diphtheroid infection, or infection due to the pseudodiphtheria bacillus, as proven by animal inoculation. A number of wound and complicated abscess infections of the pseudo-bacillus type have been reported and successfully treated with vaccines by Heath. There is such a close relationship between diphtherial and pseudodiphtherial infections of the mucous membranes, where they have been heretofore compared, that a reference to cutaneous diphtheria must first be made, cutaneous involvement secondary to faucial, nasal, conjunctival, or vaginal diphtheria is seen much more frequently. However, this is not an extremely common condition, as shown by the statistics compiled by Filatow from St. Anne's Hospital, Vienna, from 1894 to 1902, where only 23 cases were seen among 2217 diphtheria patients treated. The infection in this type of cutaneous diphtheria occurring secondarily to mucous membrane infection takes place first by continuity of structure from mucous membrane to skin—as in extension from the nares on to nose and lips, as in vaginal extension to the external genitalia—or, as is occasionally seen in the laryngeal type, with an extension from a tracheotomy wound on to the surface of the neck; and, second, by transplantation of the bacilli to distant parts, the implantation occurring on an abraded surface, a scratch or a blister as in one of the cases reported by Guthrie, who, while suffering from a faucial diphtheria, developed pneumonia, for which he was blistered on the back, and subsequently developed cutaneous diphtheria at the site of the blister. A number of cases illustrating this type have been reported. McCollom states that diphtheritic lesions of stomach and duodenum are occasionally found. Durk, Gunther and Müller have reported intestinal cases, and Schodel has isolated the diphtheria bacillus from the fæces; these findings might explain the few cases of perianal diphtheria on record. The perianal region in infancy or early childhood is frequently the site

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

of excoriations, intertrigo, eczema, etc., which are etiological considerations in the development of such a lesion.

I have found reports of 25 cases of primary cutaneous diphtheria without simultaneous or subsequent mucous membrane involvement, and in order to make clear the clinical appearances with which the infection may clothe itself, it is necessary to recall, in a brief way, portions or extracts of the clinical reports of some of these cases.

Bolton and Schöttmuller report diphtheritic ulcers in groins of two children under two years of age; Bolton's case developed extensive paralysis. Heelis and Jacob make a most interesting report of four cases from the same dormitory of an orphanage, which had been quarantined on account of a case of faucial diphtheria. Two of these patients were suffering from frost-bitten blisters on dorsum of toes, a third from the same condition on her heel; all three developed cutaneous diphtheria at the named locations; the fourth developed a similar lesion on the dorsum of her hand. Hassenstein, Toch, Freymuth, and Petrusky report diphtheritic ulceration of the umbilicus in infants. Fleisch's case was that of an infant, 2½ months old, previously burned, who was kissed by a person suffering from diphtheria of the throat. Patterson's case concerns a young woman with a lesion on her right forefinger, who subsequently developed paralysis of all extremities. Gunther reports a case in a girl, two years old, suffering from an acute phlegmon of the abdominal wall with vesiculation resembling erysipelas. Ehrhardt reports 3 such cases without mucous membrane involvement, and 1 with subsequent throat infection. Sowade's case showed multiple ulcers on the right arm and thorax, soon after vaccination, in a child of nine months. Guthrie quotes Rosenthal, as follows, in describing the death of Griesinger: "A perityphlitic abscess had been opened, which subsequently became infected with Klebs-Löffler bacillus after it had healed. He later developed a wide-spread paralysis involving all extremities, speech, deglutition; dying on the seventieth day from respiratory paralysis." Post's case was that of an adult male, who had cared for his brother-in-law, wife and child during their illness from diphtheria. His lesion was on the foreskin, complicated with an acute phimosis, and was 4 weeks old on his entry to the hospital. A dorsal incision, having been made by his physician, was covered with the diphtheritic membrane, from which bacilli resembling morphologically the diphtheria bacillus were obtained, but not until bilateral ciliary and paralysis of all extremities had supervened. McCollom adds that several similar cases have been observed at the South Department of the Boston City Hospital, and that diphtheria of the penis is more frequent than is generally supposed. Kerr, Sack, Gerloczy, Dutschlander and Schucht have observed cases of cutaneous diphtheria unassociated with mucous membrane infection, in addition to these just referred to. There have been reported by Toch, Freymuth, Petrusky and Reichold, Veiel, Sharp and Bertelli, 5 cases of primary cutaneous diphtheria, with secondary mucous membrane infection. In Sharp's case the lesions were multiple over the chest and face, with secondary involvement of the throat; Bertelli's case, confirmed by animal inoculation, was a colleague who had a blister on the upper lip while treating a case of diphtheria of the throat; the blister became the seat of a diphtheritic infection, covered with membrane, and subsequent throat infection, which yielded promptly to antitoxin subcutaneously, without causing improve-

ment in the cutaneous lesion (to this he applied Bandis bivalent serum; the wound healed in a few days). Slater reports a case of 3 years' duration in a female, with multiple lesions on the body, probably originating in the conjunctiva, with later ear and vaginal involvement. The case had received all sorts of local treatment and had been under antisyphilitic treatment for 2 years. Finally, after careful bacteriological study, the cause was determined, and treatment by the use of antitoxin subcutaneously instituted. At the end of 5 weeks, all lesions had healed and the patient was considered cured.

CASE REPORTS

CASE I.—I wish to add the report of a male, forty-seven years old, school janitor, referred to Dr. Gibbon's service at the Jefferson Hospital by his physician, Dr. Roberts, of Llanerch, Pa. About November 12, he was helping to fumigate, and scrubbing the floor of a school then quarantined, on which a child supposed to be ill with diphtheria had vomited. During this time he suffered an abraded wound of the left middle finger on the dorsum of the second phalanx, a "blood-blister" resulting. Two days later, yellowish-gray streaks appeared about the wound, with pain, swelling and stiffness of the distal joint. On the third day, his physician incised it, applied antiseptic dressing, and later flaxseed poultices; at the end of a week, a membrane or grayish slough had appeared. Similar treatment was continued for some time at the Dispensary of the Jefferson Hospital, without improvement. He was suffering slight constitutional disturbance, vague, shifting pains over body and extremities, with loss of appetite. Two Wassermann reactions had been done and found negative. The wound at this time was covered with a dirty, yellowish-gray slough, fibrous and adherent, extending down to the extensor tendon. The edges were slightly elevated and indurated, presenting an indolent appearance, and covering all of the dorsal surface between the second and third joints (Fig. 1). At this time Dr. Rosenberger was asked to make bacteriological studies, and his report is as follows: "Inoculations were made from the wound upon agar and incubated for 24 hours at 37° C.; at the end of this time, an abundant growth developed, which was of a light lemon-yellow color; spreads made and stained with Löffler's methylene blue, and by Groves method, showed bacilli (Gram-positive) possessing the morphology of diphtheria bacilli, together with few staphylococci; a guinea-pig was inoculated with 2 c.c. of a 48 hour old bouillon culture, which was absolutely negative as to tonic effects. In bouillon, the growth was manifested by a sediment, in gelatine no liquefaction nor gas production. A vaccine was made from a 24 hour old growth upon agar, and each cubic centimetre of vaccine contained approximately 500 million bacilli; 1 c.c. of the vaccine was given at a time, and four doses were



FIG. 1.—Case I. Diphtheritic ulcer of finger.

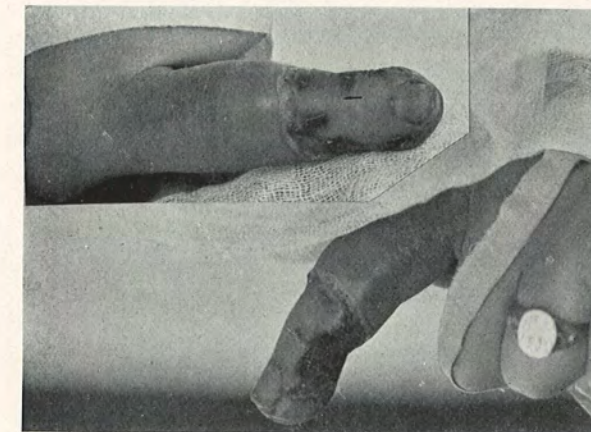


FIG. 2.—Diphtheritic ulcers of finger (condition presented in Case II).

given at four-day intervals, the patient soon began to improve and the wound healed without further trouble."

CASE II.—A girl of seventeen years, with lesion on dorsum of left index finger, almost encircling it, between second and third joints (Fig. 2), began six weeks before admission to Pennsylvania Hospital, Out-patient Department (service of Dr. Stewart), which was January 19, 1915. The trouble began with a pin-scratch; she was treated at another hospital for four weeks, and by her physician, Dr. Hickby, who referred her to the hospital, for two weeks. The wound edges were sharply defined and slightly elevated, showing some redness and induration; the surface of the wound was covered with the characteristic grayish fibrous membrane, and was difficult to remove, which exposed the extensor tendon and matrix of the nail. She had slight constitutional symptoms, with little elevation of temperature that was never recorded above 100°, and the pain seemed less than in the usual acute infection.

Bacteriological examination showed bacilli possessing the morphological characteristics of the Klebs-Löffler bacillus with a few staphylococci. The treatment consisted in the local use of diphtheria antitoxin in the form of a wet dressing on gauze covered with rubber dam to maintain moisture. This dressing was changed every 24 hours for 5 days, when the membrane had disappeared, leaving a clean granulating surface, which healed in about 4 weeks. Unfortunately, the first culture was destroyed before animal inoculation was done, and we were unable to get another after the employment of the antitoxin in spite of repeated efforts.

A summary of the review of these cases of cutaneous diphtheria would seem to show that it is usually secondary to mucous membrane diphtheria; that primary cutaneous diphtheria is an infrequent infection which may manifest itself in a single lesion, or in multiple concomitant lesions distributed over a wide area, or in the form of cutaneous and subcutaneous phlegmon, with considerable induration without marked pain, and without fluctuation or suppuration, if not complicated with pyogenic bacteria; and, finally, it may appear in the form of cellulitis with vesiculation resembling erysipelas. The infection is most apt to take place in wounds offering the most blood serum for the growth of the bacillus, as in blisters. Paralysis, as in other forms of diphtheria, is not an unusual complication, or sequel, and is usually widespread. We also find that pseudodiphtherial cutaneous infection occurs as it does on mucous membranes, and the clinical picture presented is identical with that of cutaneous diphtheria, and cannot be differentiated

except by animal inoculation. It is obvious that the clinical manifestations resulting from cutaneous infection by the diphtheria bacillus may be as diverse as the changes of environment governing the infection, which only make the appearance of the lesion or lesions more deceptive to the diagnostician. Hence the ease with which it has been mistaken for some of the syphilitic lesions, a tubercular process, a phlegmon, or some widespread skin affection. The treatment of cutaneous diphtheria resolves itself into that of diphtheria of any other part, viz.: the use of antitoxin subcutaneously or locally, or both, and for pseudodiphtherial skin infections, the use of the autogenous vaccines would seem to be the treatment of choice, and, of course, local surgical cleanliness in both conditions.

I am deeply indebted to Doctors Gibbon and Despard for the privilege of reporting the first case, and to Dr. Stewart for the privilege of reporting Case II, and to Dr. Rosenberger for his careful bacteriological study and the preparation of the vaccine in Case I.

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DR. J. STEWART RODMAN related the history of a little girl operated on three years ago at the Medico-Chirurgical Hospital for appendicitis with abscess. The wound was allowed to remain open for drainage. When drainage had about ceased and when the granulating wound was perfectly healthy, a diphtheria epidemic broke out in the children's ward. Several days after the outbreak of this epidemic a grayish membrane appeared on the granulations in the wound, which kept reforming in spite of being stripped off when the wound was dressed. Finally it occurred to some one that it would be well to have a bacteriological examination made, and there proved to be a local infection of the wound with diphtheritic infection. The child was removed to the Municipal Hospital, made a complete recovery and was subsequently operated on for ventral hernia.

ARTHROPLASTY OF THE ELBOW*

BY ASTLEY PASTON COOPER ASHHURST, M.D.
OF PHILADELPHIA

I HAVE adopted arthroplasty of the elbow-joint in five patients: twice for bony ankylosis, and three times for marked limitation of motion following fracture.

TECHNIC OF THE OPERATION.—I. *Exposure of the Joint.*—The skin incision (Fig. 1)¹ begins on the external supracondylar ridge of the humerus, about 5 cm. above the joint, and is continued straight downward to the joint level where it is curved slightly backward toward the extensor surface of the forearm; its entire length is about 10 cm. This incision is carried down to the supracondylar ridge above the joint; below the joint level the deep fascia is exposed but is not incised. The soft parts are then cleared from the humerus: the brachioradialis and the extensor carpi radialis longior are displaced forward and the triceps backward, *thoroughly* exposing the external condyle, the anterior capsule of the joint, and the external lateral ligament with the origin of the extensor muscles (Fig. 2). The external condyle is then detached from the humerus by osteotome, the bone section entering the elbow-joint on the capitellar surface of the humerus. In most cases even when the ulno-humeral joint is ankylosed the radio-humeral joint is free, and the external condyle may be easily turned downward on the external lateral ligament as a hinge, exposing the joint (Fig. 3). If ankylosis is present between the radius and humerus it is easy to separate them by gouge without injury to the external lateral ligament. In order to turn the condyle downward sufficiently to expose the joint thoroughly, the capsule must be snipped with scissors in front of and behind the external lateral ligament.

2. *Dislocation of the Joint.*—If ankylosis exists between the ulna and humerus these bones are separated by a suitably shaped gouge, driven transversely across the joint by smart blows from a hammer. When the union has been almost completely divided, the remaining fibres on the inner side of the joint may be ruptured by abrupt, short, forceful movements of flexion and extension applied to the elbow-

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

¹ The accompanying illustrations (Figs. 1 to 10) are from photographs of preparations in the Laboratory of Operative Surgery in the University of Pennsylvania.

joint. If one fears injury to the ulnar nerve a small incision may be made over its course between epitrochlea and olecranon, and the nerve may be drawn away from the bones. Only in one case did I find this necessary.

Ankylosis having been overcome, or in cases where no ankylosis is present, the elbow-joint is dislocated by adducting the forearm around the internal lateral ligament, as a hinge, until the forearm lies almost parallel with the upper arm, causing the ends of the humerus, radius and ulna to come into full view (Fig. 4).

3. *Shaping the Bone Ends.*—As little as possible is done to the ulna, especially when the head of the radius is healthy. Reliance is placed on resection of the humerus for shaping the new joint (Fig. 5). If ankylosis exists in the upper radio-ulnar joint it is simpler to resect the head of the radius than to turn in a flap between radius and ulna. For shaping the humerus a Gigli wire saw mounted in a bow-shaped frame (the saw of Pierre Delbet) is the most convenient instrument; with this a series of cylindrical sections can be removed from the humerus until enough room is secured between the bone ends. Seldom is it necessary to remove any bone above the level of attachment of the internal lateral ligament at the base of the epitrochlea.

4. *Interposition of the Flap.*—The bones being temporarily restored to their normal relations, the original skin incision is extended backward from its upper end across the posterior surface of the arm (Fig. 6). The triangular skin flap thus outlined is raised, including a fair amount of subcutaneous fat, until the superficial surface of the triceps, or of the fat and fascia covering it, is fully exposed. An interposing flap of fat and fascia is then raised from the superficial surface of the triceps, with its base at the olecranon (Fig. 7). It is best to include some of the triceps aponeurosis and muscular fibres in this flap. The elbow-joint is then partially dislocated again, and the flap is attached to the internal lateral ligament of the elbow, and to the anterior and posterior capsules of the joint, by a few interrupted sutures of chromicized catgut (No. 0), thoroughly covering the articular surface of the humerus (Fig. 8).

5. *Closure of the Wound.*—The forearm is restored to its normal relation with the arm, and the external condyle is brought up in front of the pedicle of the interposing flap, and is fixed to the humerus (Fig. 9). For this purpose I prefer Lambotte's self-boring screws; in the accompanying illustration a nail was employed because at the time (in the Laboratory of Operative Surgery) no such screws were at hand. I have also used chromic gut and phosphor bronze wire

sutures, but have found them inferior to the Lambotte screws in obtaining secure fixation. Two screws are better than one. If much bone has been removed from the humerus, it will be necessary to trim the external condyle to fit.

The triceps is then sutured accurately to the brachioradialis and extensor muscles, the deep and superficial fasciæ are accurately approximated, and finally the skin wound is closed (Fig. 10). No drainage is necessary. Interrupted chromic gut sutures (No. 1 or No. 2) are employed throughout. Rarely is a single ligature required.

The average time I have consumed in the operation is about one hour and thirty minutes.

CASE HISTORIES

CASE I.—*Malunion of fracture of external condyle; limited motion and cubitus varus.* James W., aged five years. Treated in Dr. Frazier's service at the Episcopal Hospital. Fractured the external condyle of his right humerus in July, 1908; and first came under my care in October, 1908, for limited motion (50 to 145 degrees) and cubitus varus (200 degrees). A skiagraph showed a fracture with outward rotation of the external condyle, but bony union. For six weeks subsequently light massage and passive movements were employed, but the range of motion improved only 10 degrees in flexion (40 to 145 degrees). Fig. 11 gives a photograph taken before operation.

Operation (November 18, 1908).—Usual external incision. Enough of the external condyle was removed (without detaching it from the humerus) to permit full extension of the elbow, as well as to overcome the cubitus varus. The olecranon fossa on the posterior surface of the humerus was also deepened. A fatty fascial flap from the superficial surface of the triceps was turned in over the denuded external condyle and the wound closed. The elbow was dressed in hyperflexion.

At the first dressing, ten days later, the wound was healed and the skin sutures absorbed. Motion was free and painless from 45 to 90 degrees. The arm was now carried in a sling. On December 5 there was motion from 40 to 140 degrees.

In May, 1912, three years and a half after operation, the boy was presented at a meeting of the Philadelphia Academy of Surgery, exhibiting perfect function, no varus deformity, full flexion, but extension only to 150 degrees (ANNALS OF SURGERY, 1912, ii, 647). Fig. 11 shows photographs made in March, 1915, more than six years since operation.

CASE II.—*Malunion of fracture of lower end of humerus; limited motion and cubitus varus.* William G., aged eighteen years.

Treated in Dr. Harte's service at the Orthopædic Hospital. Referred by Dr. E. H. Kistler, of Lansford, Pa. When three years old this boy had fallen out of bed, landing on his left elbow. He recovered with Volkmann's contracture of the forearm, cubitus varus, and limited motion in the joint (40 to 110 degrees). When first seen, August, 1912, the Volkmann's contracture caused him no inconvenience, but the limited extension in the elbow was a serious handicap in his work in the mines, and his elbow was weak from the varus deformity and pained him if he used it much. Photographs made before operation (Fig. 12) show the distortion of the bony points at the elbow and the limit of extension (× indicates head of radius; the condyles and the olecranon are indicated by dots).

Operation (September 2, 1912).—Through the usual external incision the head of the radius, which projected far backward (Fig. 13), was exposed posterior to the external lateral ligament, and was excised. The external condyle was then detached, the joint luxated, and a curved section was removed from the humerus, with Butcher's saw, much more bone being removed from the radial than from the ulnar side of the humerus, so as to overcome the varus deformity. Fig. 14 shows the portions of bone removed, that from the humerus having been removed in three sections, until the sawn surface fitted the ulna and the varus deformity was abolished. A flap of aponeurosis and muscle was secured from the triceps in the usual way. The epicondyle was re-attached to the shaft of the humerus with chromic gut. A drainage tube was placed at each end of the incision. The tubes were removed after three days. It was not necessary to have employed them. The arm was dressed on a straight anterior splint, at an angle of 160 degrees.

September 5: Motion from 90 to 135 degrees is easy.

September 19: Out-patient. Sinuses (resulting from unnecessary use of drainage tubes) have healed. Motion 90 to 160 degrees is easy. He carries his arm in a sling.

October 3: Motion 65 to 135 degrees. Ordered massage and light passive movements three times weekly.

October 17: Treatment discontinued. Motion 65 to 160 degrees. Returns to work.

July 31, 1913: Eleven months after operation the patient was again photographed (Fig. 12), to show the range of motion (40 to 170 degrees). There was no cubitus varus and perfect function. The elbow is stable. He works on a breaker engine at the mines.

CASE III.—*Bony ankylosis from metastatic arthritis.* Gertrude T., aged twenty-three years. Treated in Dr. Harte's service

at the Orthopædic Hospital. In May, 1912, when about seven months pregnant, but without any evident cause (such as preceding tonsillitis, influenza, vaginitis, etc.) this patient developed an acute polyarthritis and was confined to bed for seven weeks. The pregnancy terminated normally after convalescence, but the left elbow and right knee were ankylosed. When first seen at the Orthopædic Hospital, in March, 1913, about ten months after this attack of arthritis, the elbow was fixed in bony ankylosis at an angle of 110 degrees; fortunately the radio-humeral joint and the upper radio-ulnar joint were not involved, as rotation in the forearm was normal.

Operation (May 1, 1913).—Arthroplasty of elbow by usual technic. A small incision was also made over the ulnar nerve and this was drawn away from the internal condyle until the bone ends were properly shaped. Flap obtained from triceps as usual, and epicondyle reattached to humerus by wire suture. No drain. Dressed on internal right-angled splint.

May 12: First dressing. Inner incision healed; outer incision healed all but one spot, between two sutures at upper end, over the cavity resulting from cutting the triceps flap. A little serous ooze occurred at this point. Motion of 30 degrees free and painless. Can get hand to mouth. Arm carried in sling.

May 15: Motion from 70 to 120 degrees without pain. Rotation in forearm normal. Can put hand to back of neck.

May 23: Passive motion from 65 to 160 degrees without pain. Active movement from 70 to 120 degrees. Arthroplasty of the knee was done to-day (*Trans. Coll. Phys. Phila.*, 1914, xxxvi, 236), and on this account the patient had to remain in the hospital longer. Fig. 15 shows the condition on admission, and Figs. 16 and 17 show respectively the limits of flexion and of extension in elbow and knee three months after operation. Figs. 18 and 19 are from skiagraphs made before and after arthroplasty of the elbow.

October 17, 1914: Eighteen months after operation there was motion in the elbow from 45 to 150 degrees, there was active power of extension in the triceps, and the joint was quite stable. She does all her own housework, and finds it a very useful arm.

CASE IV.—Malunion of fracture of lower end of humerus, with limited motion. Benjamin F., aged fourteen years. Treated in Dr. Ashhurst's Orthopædic Service at the Episcopal Hospital. In the summer of 1912 this boy fell on his elbow and sustained a fracture-dislocation of the type Posadas (diacondylar fracture of the humerus with forward displacement of the lower fragment and posterior dislocation of both bones of the forearm). Neither the fragments of the humerus nor the dislocation of the elbow had been reduced, and 16 months later the boy applied to the



FIG. 1.—Arthroplasty of elbow; skin incision.

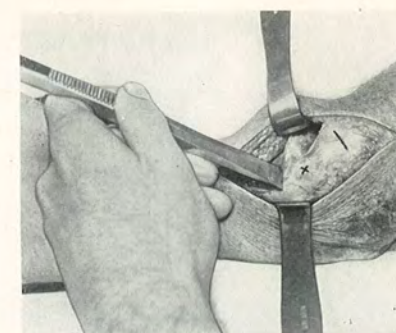


FIG. 2.—Arthroplasty of elbow; external condyle (X) and head of radius (—) exposed, and osteotome applied to external condyle.

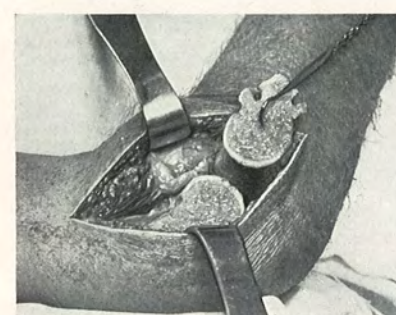


FIG. 3.—Arthroplasty of elbow; external condyle turned down, exposing joint.

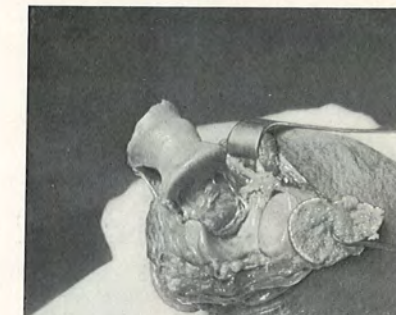


FIG. 4.—Arthroplasty of elbow; joint luxated around internal lateral ligament as a hinge.

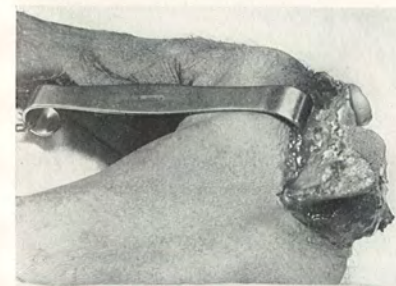


FIG. 5.—Arthroplasty of elbow; articulating surface of humerus removed with saw. Joint is viewed from outer side; the external supracondylar ridge and the surface from which the external condyle has been detached face the reader, and the joint surface of the humerus (freshly sawn) is directed toward the right of the picture.

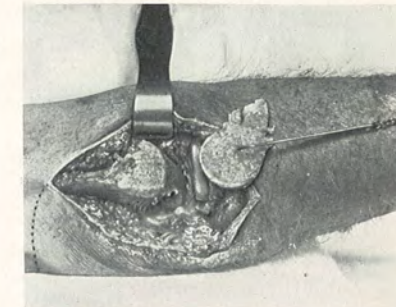


FIG. 6.—Arthroplasty of elbow; bones replaced; dotted line indicates extension of primary skin incision, to expose triceps.

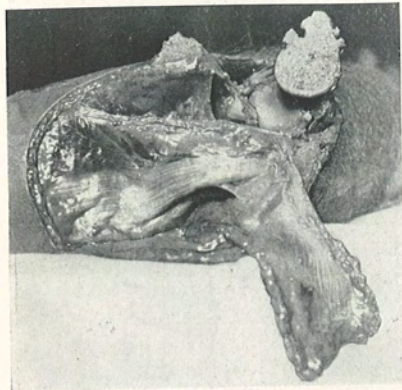


FIG. 7.—Arthroplasty of elbow; fat and fascia pedicled flap cut from surface of triceps.

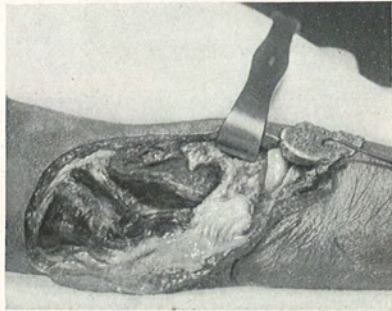


FIG. 8.—Arthroplasty of elbow; flap turned into joint covering articular surface of humerus. Same view of joint as Fig. 6.

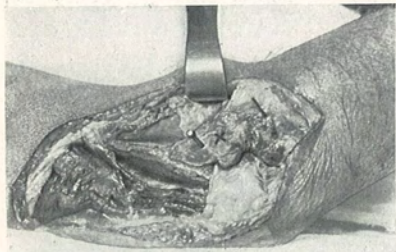


FIG. 9.—Arthroplasty of elbow; external condyle has been replaced and fastened by a screw or nail.

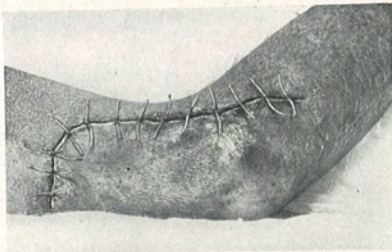


FIG. 10.—Arthroplasty of elbow; skin sutured.

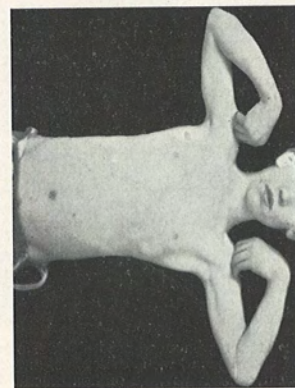
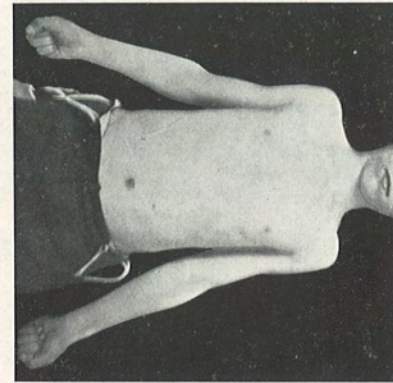
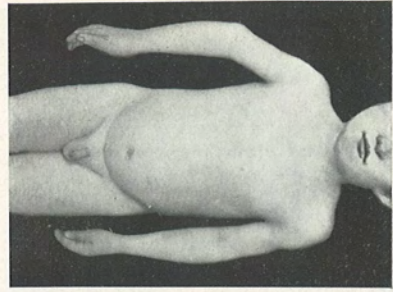


FIG. 11.—Case I. A is a photograph taken in 1908, just before operation, showing cubitus varus. B and C are photographs taken in 1913, showing restoration of carrying angle and limits of extension and flexion.

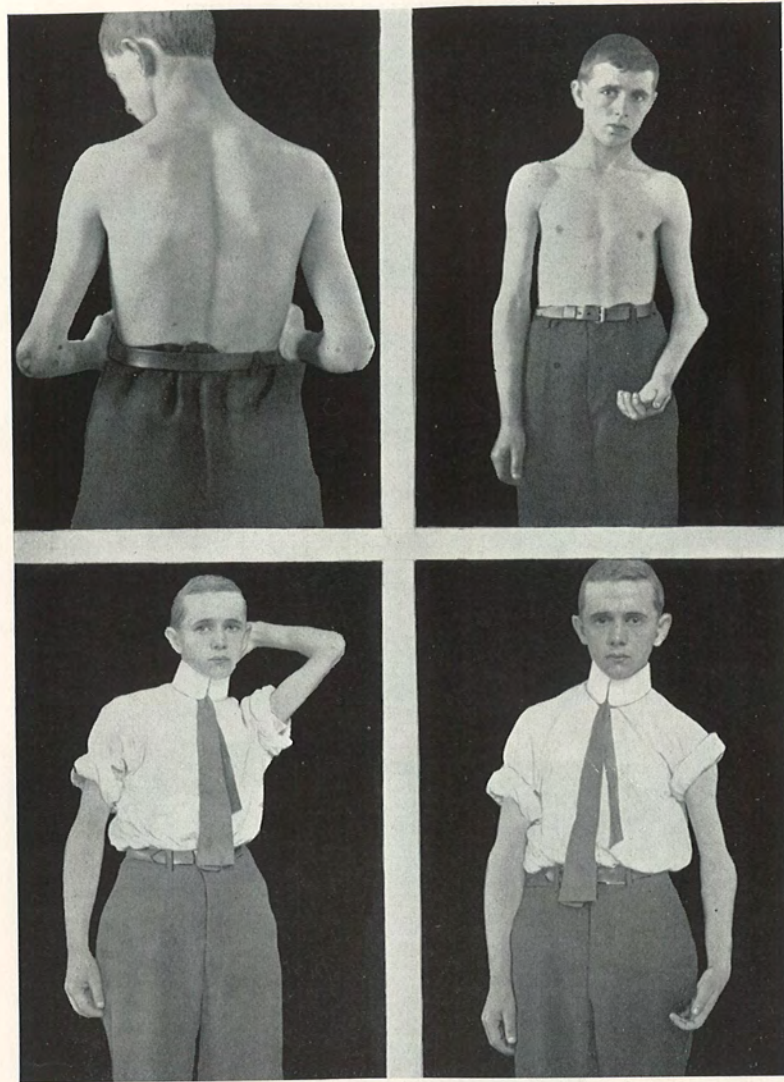


FIG. 12.—Case II. The first two photographs were made before operation, showing distortion of bony landmarks (X indicates head of radius) and limit of extension. The other two photographs were made eleven months after operation, showing range of flexion and extension, and restoration of carrying angle.

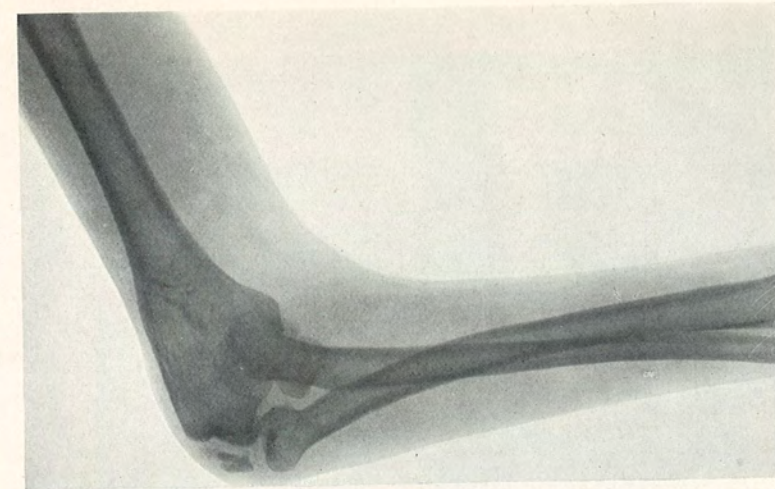


FIG. 13.—Case II. Skiagraph before operation, showing marked cubitus varus and limitation of extension.

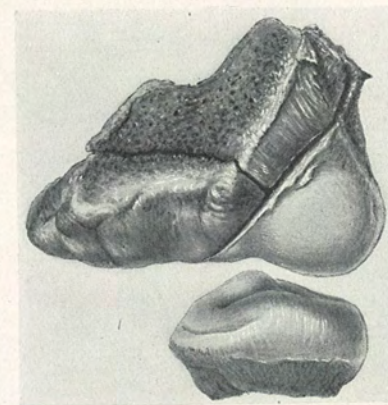


FIG. 14.—Case II. Arthroplasty of elbow; portions of humerus and head of radius excised (September, 1912).



FIG. 15.—Condition of Case III on admission.

FIG. 16.—Showing amount of possible flexion in Case III on discharge.

FIG. 17.—Showing amount of extension possible in Case III on discharge.

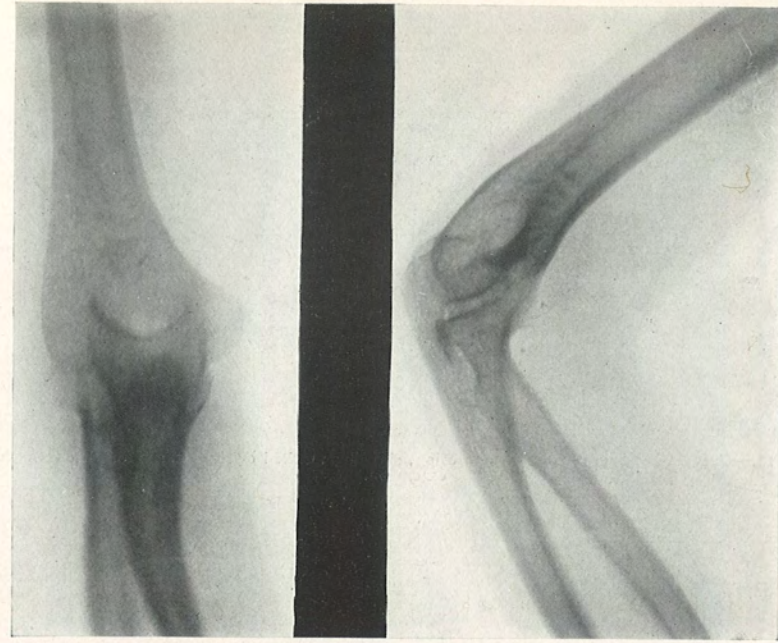


FIG. 18.—Case III. Skiagraphs showing ankylosis of elbow before arthroplasty.



FIG. 19.—Case III. Result of arthroplasty. From skiagraph seven weeks after operation.

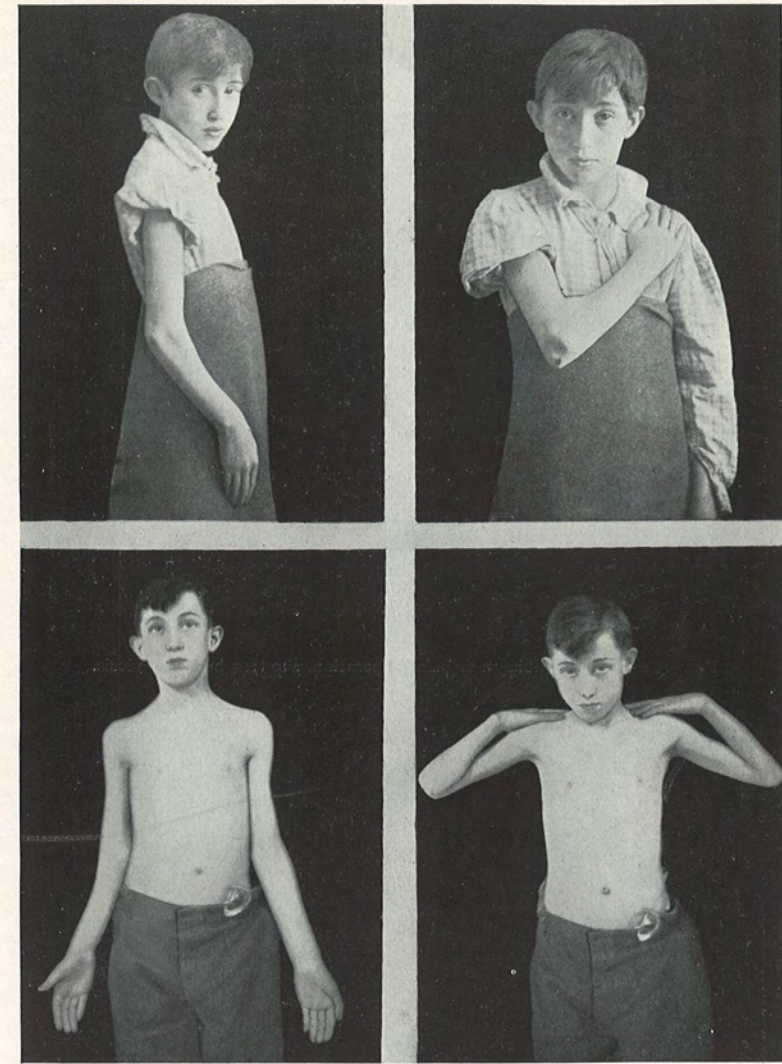


FIG. 20.—Case IV. Upper photographs show limits of extension and flexion before operation. Lower photographs were made five months after operation, showing results of arthroplasty.

around the screws causes them to loosen, with consequent shifting of the plate. Those plates that remain *in situ* for several years are merely exceptions to the rule. It is most illogical to put metal into bone, and he foresaw that Dr. Albee's bonegraft inlay and peg methods had sounded the knell of all metal fixtures.

Continuing the comparison between bone and soft tissues, take, for example, a nerve that has been divided for some time. There are bulbs of scar-tissue at the ends. The ends are perfectly contacted, but one never gets union. Why? Because the nerve-fibres cannot penetrate the barrier of scar-tissue. When, on the other hand, the bulbous scarred ends are removed until the brush-like ends of the fibrillæ stand out, and the freshened ends are *accurately* contacted, regeneration occurs, and the nerve resumes its property of conduction. The same state of affairs is met with in an old, ununited fracture. The ends of the fragments are sclerosed (scar-tissue), and with the plate we get contact without union, for the same reason, unless the ends be resected. By the bonegraft inlay method of Albee, on the other hand, healthy bone spans the sclerosed area, and assures union by its osteogenetic, as well as osteoconductive, properties.

DR. ALBEE, in closing, said that he had seen silver wire break in several instances in fracture of the patella, in one case coming through the skin. Silver wire in ununited fractures is most untrustworthy. Fixation is a secondary consideration. Something is required to span the sclerosed bone and complete the contact with healthy bone beyond the point of fracture, something that will not only supply bone callus but that will stimulate osteogenesis, and this the bone graft does. He was equally certain that in relatively large grafts a varying part of the central portion acts as a scaffold for migrating bone-cells from the fragments. The reconstruction of the graft is a physiological affair. Regarding extrusion of the graft, there was one case where the graft was applied to the jaw, and the wound connected with the oral cavity, in which practically all the graft came out. In only two in 400 cases has the whole graft been extruded. He had had in several cases little slivers come out. The whole graft has been laid bare by an infected wound and has become covered up with granulations; perhaps little shells have come off, but the graft has served its purpose. It is a most trustworthy surgical agent and of an entirely different class from metal. It has a definite resistance to infection. He had had no experience in the use of the graft in jaw fractures. Some of his cases of fracture of the neck of the femur had been of long duration (*i.e.*, up to two and one-half years).

STATED MEETING, APRIL 5, 1915

The President, DR. JOHN H. GIBBON, in the Chair

GYNÆCOMASTIA

DR. NATHANIEL GINSBURG presented a man, nineteen years of age, in whom for six months the left breast has slowly and steadily increased in size without evidence of pain, and at present presents the appearance of a young female breast about puberty or a little later (Fig. 1). There is prominence of the nipple and distinct mammary tissue hypertrophy, with an areola of pigmentation about the nipple which is more marked than present on the right side. There is no record of antecedent injury, unless his occupation (a shoemaker) has predisposed him to occupational traumatism to this region. The breast tumor is a diffuse, somewhat circumscribed, enlargement, corresponding anatomically to the normal young adult breast outlines. There is no fixation or retraction of the nipple. There is no mammary secretion and no enlargement of the axillary lymph-nodes. Dr. John Speese (ANNALS OF SURGERY, April, 1912) regards this type of benign tumor in the young male breast as an adenofibroma and I am in agreement with his views, believing this case will histologically conform to that type of tumor. I do not believe this case in its inception could have been termed "Adolescent Mastitis" unless this is synonymous with adenofibroma.

DR. JOHN H. GIBBON (Transactions of the Philadelphia Academy of Surgery, April, 1912) reported the case of a young man twenty-one years of age, also a shoemaker, upon whom he had operated; and examination of whose tumor showed it to be an adenofibroma of the breast.

This is an unusual and rare breast tumor in the male, and since it is steadily increasing in size, with a view of removing the malignant potentiality present, I have advised and shall perform a plastic resection with preservation of the nipple.

Note.—Plastic resection of the breast and histological examination showed the breast enlargement to be a case of gynæcomastia.

DR. PENN G. SKILLERN, JR., disagreed with Dr. Ginsburg in his diagnosis of neoplasm, and regarded it as a case of unilateral gynæcomastia, or physiological metamorphosis of the male breast into the

female type, of which there are now about one hundred and ten cases on record. In support of this view, he related the history of the following case, which was seen by him in the Surgical Out-patient Department of the University Hospital (Case-record 39964), March 4, 1914, and reported, together with a photograph, in *International Clinics*, 1914, 24th series, vol. ii, p. 238.

A white male, aged nineteen years, single, student, stated that for the past two years he has noticed a gradual enlargement of the left breast, and that as the result of conversation with some medical students he feared he was getting a cancer. Examination revealed no neoplasm, but a well-developed left breast, corresponding to that of a sixteen-year-old girl. The right breast, the genitalia, and the sexual instincts were wholly masculine. Chiefly for cosmetic reasons, but also to anticipate the malignant degenerations to which anomalous structures are notoriously liable, a plastic operation was performed a year later.

Gynæcomastia may be bilateral or unilateral, and when one breast alone is involved, it is more often the left. Many cases are associated with anomalies of other portions of the reproductive apparatus, such as hypospadias, absence of pubic hair, etc. At times there is a familial predisposition. It might be expected that such an anomaly would show degenerative changes, such as increase in the amount of fibrous tissue, and atypical architecture of the mammary tissue itself. These changes, however, must be considered as part and parcel of this condition, and, *per se*, do not justify the microscopical diagnosis of neoplasm. A tumor could hardly make a male breast mimic so perfectly a female.

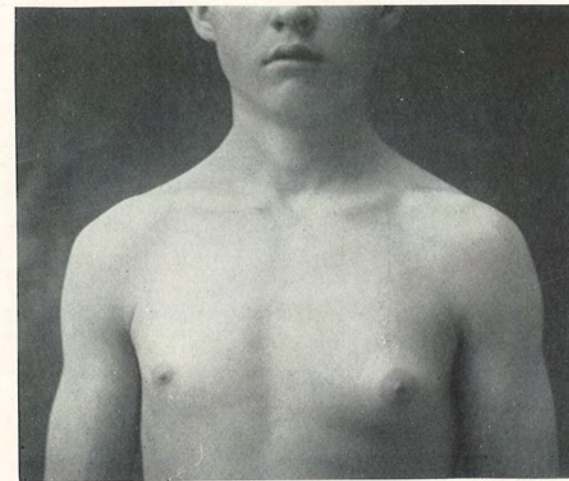


FIG. 1.—Hypertrophy of breast in a young adult male.

ON FRACTURES OF THE SESAMOID BONES OF THE THUMB*

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THE following case represents the fourth example of fracture of a sesamoid bone of the thumb to be recorded in the literature.

E. B., male, white, aged twenty-six years, civil engineer, reported at the Surgical Out-patient Department of the University Hospital (Case record 61996) on March 2, 1915, with the history of having fallen three days previously in such manner that the left thumb was traumatized against the granite Belgian block pavement.

This hand had never been injured previously. Clinical examination revealed moderate swelling of the left thumb, ecchymosis along the thenar eminence, and "wincing" tenderness both at the head and at the base of the first metacarpal. A clinical diagnosis was made of a "chipping" fracture of the metacarpal head. Skiagram (Fig. 1) revealed a fracture of the ulnar sesamoid bone opposite the head of the first metacarpal, the smaller fragment being separated distally, and there being a definite, dentate line of fracture. There was also an oblique fracture at the base of the metacarpal, separating the ulnar corner and entering the carpo-metacarpal joint at its middle. The thumb was immobilized in extension and slight abduction by a spica sodium silicate bandage.

Re-examination after the reading of the skiagram brought out two additional facts. In the first instance, the patient was loose-jointed, and could hyperextend both thumbs normally at the metacarpophalangeal joint. In the second place, there was definite "wincing" tenderness, localized to the ulnar sesamoid bone. After four weeks the immobilizing dressing was removed, and massage instituted.

While the clinical diagnosis of "chipping" fracture of the metacarpal head was inaccurate, yet it was close enough to lead to the detection of the fracture of the sesamoid bone. In order to parry the question of a congenitally bipartite sesamoid, a skiagram of the right thumb was taken (Fig. 2), but no abnormality of the sesamoids was revealed. This fact, together with the history of a fall upon the thumb, the clinical localization of "wincing" tenderness to the sesamoid, shown

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

involved by the skiagram, and the dentate line of the fragments in the skiagram contrasted with the smooth line of a bipartite sesamoid, points to a fracture.

The other three cases were found only in the German literature.

The first case was reported by Preiser, in 1907 (*Aerzt. Sachverstaendigenzeitung*, 1907, No. 19, S. 400). The patient was a woman, aged thirty years, who had fallen upon the right hand, fracturing both of the sesamoids of the thumb.

The second case was observed by Morian, in 1905, but not reported until two years later, nor published until 1909 (*Deutsch. Zeitschr. f. Chirurg.*, 1909, H. 102, S. 394). The patient was a man, aged twenty-seven years, whose right thumb was caught between a closing door and the jamb. Skiagram revealed a comminuted fracture of the ulnar sesamoid bone.

The third case was presented by Maas, in 1912, in an inaugural dissertation entitled: "Ueber Sesambein-Frakturen" (*Emil Ebering*, Berlin, 1912, 18pp.), which reviews the subject and gives references to the literature, and which is the latest article that could be found at the time of preparation of this paper. The patient was a man, aged fifty-three years, a wheelwright by trade, who was struck upon the left thumb by the end of an unfinished metal tire. The skiagram Maas shows reveals a fracture very similar to that in my case, and involving the ulnar sesamoid bone. In this case the tire was grasped between the thumb and the index finger, resting upon the ulnar sesamoid bone, which was thus directly exposed to trauma. Skiagram of the right hand showed a normal state of the bones.

As to the nature of the violence that produced the injury, whether direct or indirect, it is difficult to decide, for the mechanism of the fall was such that the one could operate as well as the other, and arguments could be brought forth in favor of either form. The absence of comminution of the fragments, and their similarity in the skiagram to fractures produced experimentally by indirect violence, however, lead one to conclude that the latter variety of violence was effective. The three previously reported cases, on the contrary, were due to *direct* violence. But Morian criticises Preiser for rejecting indirect violence as the cause of the fracture in his patient, who, like mine, also fell upon her outstretched thumb.

Experimentally, fractures have been produced by both forms of violence. Preiser obtained results by direct violence, but could produce none by indirect violence. Morian found it easy to procure fractures by direct force, and then made eight attempts to secure fracture by indirect force, in five of which he succeeded. Of these five, in four both bones were broken (compare Preiser's case), while in the fifth the ulnar alone was involved. In all, the line of fracture was transverse or oblique, and a small fragment was separated as often proximally as



FIG. 1.—Fracture of ulnar sesamoid bone of thumb. Fracture of base of first metacarpal bone.

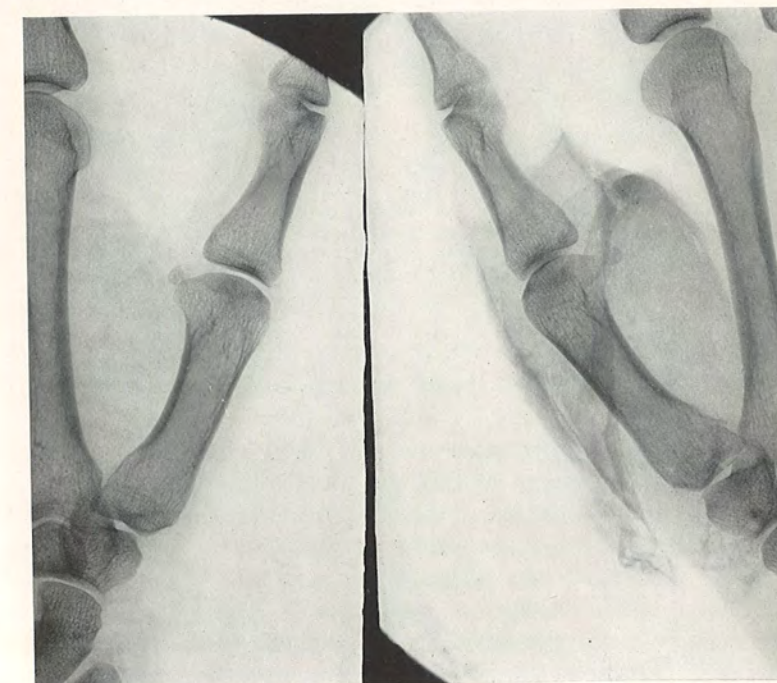


FIG. 2.—Same as Fig. 1. The normal right thumb is shown for comparison.

distally with one exception, a radial sesamoid that was broken through the middle. Clinically, fractures by indirect violence, as obtains in fractures of the patella from a similar cause, are associated with more extensive laceration of the capsule of the joint.

In an attempt to clarify the subject I examined 22 thumbs in the Anatomical Laboratory, some of the results of which are shown in the cuts (Figs. 3 to 9). The first sketch (Fig. 3) shows the normal sesamoids *in situ*. The radial is typically larger and oval, and the ulnar smaller and round, and situated more distally. Both rest upon, or close to, the anterior border of the base of the proximal phalanx.

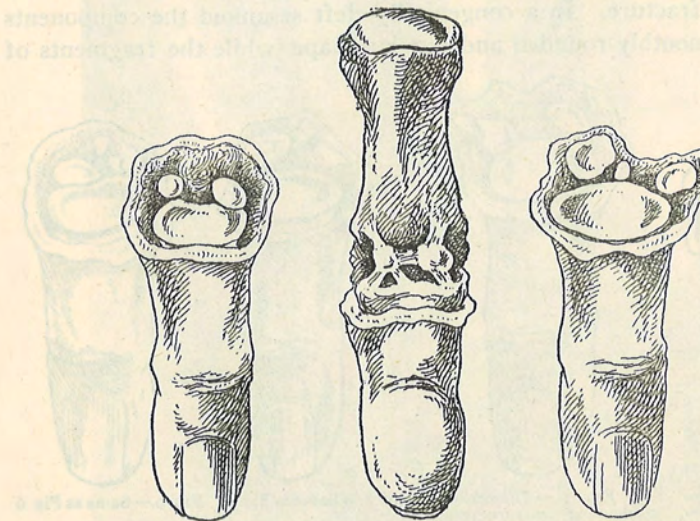


FIG. 3.—Dissection showing normal sesamoids of thumb *in situ*. Radial is large and oval; ulnar is small and round.

FIG. 4.—Dissection showing ligaments connected with sesamoids. One intersesamoid; two radial; three ulnar.

FIG. 5.—Dissection showing bipartite radial sesamoid. Note smooth, even edge.

Both are embedded in the capsule, receive insertions of muscles from the thenar eminence, and form a groove through which passes the long flexor tendon.

The second sketch (Fig. 4) demonstrates what I have been unable to find any description of, namely, definite ligaments connected with the sesamoids, aside from that which binds the two bones together. In this specimen five definite capsular thickenings were found, of which two were associated with the radial, and three with the ulnar, sesamoid. These recall in miniature the picture of the patella with its quadriceps tendon and ligamentum patellæ, and the effect of sudden, forcible hyperextension upon the sesamoids seated upon the border of

the phalanx is fairly comparable with the patella resting upon the trochlea of the femur when subjected to similar strain. Instead of the ligament itself tearing it avulses a shell of bone, as in any other tear fracture.

The third sketch (Fig. 5) shows a congenital division of the radial sesamoid: a similar condition of the same bone was also found by Preiser in his experimental investigations. Morian saw clinically a like state of the ulnar sesamoid in a patient whose daughter had a congenitally-cleft sesamoid of the great toe. But for the following points of differentiation, as emphasized by Stumme, one might be deceived by diagnosing fracture. In a congenitally-cleft sesamoid the components possess a smoothly-rounded and regular shape, while the fragments of

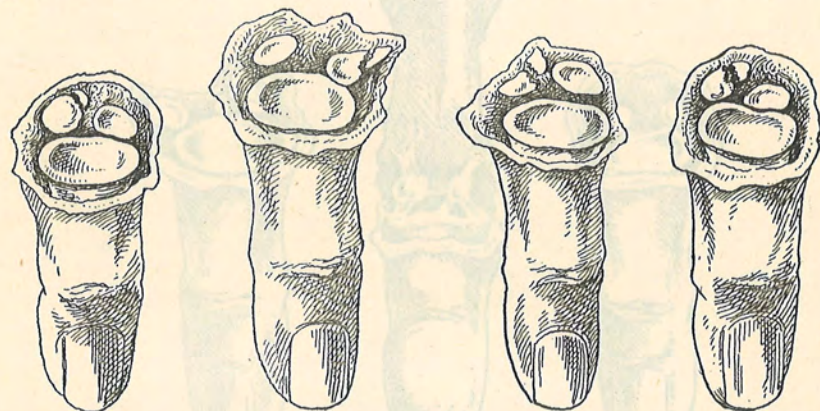


FIG. 6.—Dissection showing tear-fracture of ulnar sesamoid experimentally produced.

FIG. 7.—Dissection showing tear-fracture of radial sesamoid experimentally produced.

FIG. 8.—Same as Fig. 6.

FIG. 9.—Same as Fig. 6.

a broken sesamoid show an irregular, dentate edge on the side that corresponds to the line of fracture.

The remaining sketches (Figs. 6, 7, 8 and 9) show a series of tear-fractures. Each specimen was prepared as follows: The thumb was disarticulated at its junction with the carpus. The muscles were removed without disturbing the joints. The metacarpal bone was fixed in a vise, and with a wooden mallet a blow was struck upon the front of the thumb near its tip. Not always did the sesamoid fracture, however. In some cases the phalanx, in others the metacarpal broke into or near the joint. But of the breaks obtained the four shown are fairly typical of what one might expect in the living. In these four cases the ulnar sesamoid yielded three times (Figs. 6, 8 and 9) and the radial once (Fig. 7). In no instance were both sesamoids broken.



FIG. 10.—Hand showing a complete set of ten sesamoids opposite the metacarpal heads. An additional sesamoid is seen opposite the head of the proximal phalanx of the thumb.

The removal of the muscles showed that they play no part in the fracture.

Failure to detect a fractured sesamoid might be regarded as an inconsequential matter, but it must be remembered that the thumb is a very highly-specialized digit, capable of delicate and intricate movements, and that its crippling might be an affair of serious moment to a wage-earner.

The treatment is by immobilization in a neutral position, and for this purpose a sodium silicate dressing, left undisturbed for four weeks, fulfils all indications. It must not be forgotten that the sesamoid, like the scaphoid, is bathed by synovial fluid, and therefore heals slowly.

As to the remaining fingers, the sesamoid bones are inconstant. Citing Pfitzner, Dwight (*Variations in the Bones of the Hands and Feet*; Philadelphia, J. B. Lippincott Company, 1907, p. 11) tabulates the findings in 1440 adult hands as follows:

	I	II	III	IV	V
R.....	99.9	48.7	1.4	0	2.1
U.....	100	0.1	0	0.1	82.5

In his thesis, Maas evidently overlooked this table of Pfitzner's, for he states that the radial sesamoid of the middle finger has never been observed. According to the table, the ulnar sesamoid of the middle finger and the radial sesamoid of the ring finger were not found. I chanced upon a skiagram that shows the complete set of ten, and an additional sesamoid opposite the distal interphalangeal joint of the thumb (Fig. 10). Pfitzner has observed congenital division of the ulnar sesamoid of the little finger, as well as of the radial sesamoid of the index. I have found no instance of fracture of the sesamoid bones of the fingers, but it is quite probable that examples will be reported in the future.

DIPHThERIAL AND PSEUDODIPHThERIAL PRIMARY CUTANEous INFECTION*

By ARTHUR E. BILLINGS, M.D.
OF PHILADELPHIA, PA.

WE find, after a rather careful review of the literature, that primary cutaneous diphtheria, unassociated with infection of the mucous membrane by the Klebs-Löffler bacillus, is an unusual condition. I also am unable to find any report of case or cases of primary cutaneous diphtheroid infection, or infection due to the pseudodiphtheria bacillus, as proven by animal inoculation. A number of wound and complicated abscess infections of the pseudo-bacillus type have been reported and successfully treated with vaccines by Heath. There is such a close relationship between diphtherial and pseudodiphtherial infections of the mucous membranes, where they have been heretofore compared, that a reference to cutaneous diphtheria must first be made, cutaneous involvement secondary to faucial, nasal, conjunctival, or vaginal diphtheria is seen much more frequently. However, this is not an extremely common condition, as shown by the statistics compiled by Filatow from St. Anne's Hospital, Vienna, from 1894 to 1902, where only 23 cases were seen among 2217 diphtheria patients treated. The infection in this type of cutaneous diphtheria occurring secondarily to mucous membrane infection takes place first by continuity of structure from mucous membrane to skin—as in extension from the nares on to nose and lips, as in vaginal extension to the external genitalia—or, as is occasionally seen in the laryngeal type, with an extension from a tracheotomy wound on to the surface of the neck; and, second, by transplantation of the bacilli to distant parts, the implantation occurring on an abraded surface, a scratch or a blister as in one of the cases reported by Guthrie, who, while suffering from a faucial diphtheria, developed pneumonia, for which he was blistered on the back, and subsequently developed cutaneous diphtheria at the site of the blister. A number of cases illustrating this type have been reported. McCollom states that diphtheritic lesions of stomach and duodenum are occasionally found. Durk, Gunther and Müller have reported intestinal cases, and Schodel has isolated the diphtheria bacillus from the fæces; these findings might explain the few cases of perianal diphtheria on record. The perianal region in infancy or early childhood is frequently the site

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

of excoriations, intertrigo, eczema, etc., which are etiological considerations in the development of such a lesion.

I have found reports of 25 cases of primary cutaneous diphtheria without simultaneous or subsequent mucous membrane involvement, and in order to make clear the clinical appearances with which the infection may clothe itself, it is necessary to recall, in a brief way, portions or extracts of the clinical reports of some of these cases.

Bolton and Schöttmuller report diphtheritic ulcers in groins of two children under two years of age; Bolton's case developed extensive paralysis. Heelis and Jacob make a most interesting report of four cases from the same dormitory of an orphanage, which had been quarantined on account of a case of faucial diphtheria. Two of these patients were suffering from frost-bitten blisters on dorsum of toes, a third from the same condition on her heel; all three developed cutaneous diphtheria at the named locations; the fourth developed a similar lesion on the dorsum of her hand. Hassenstein, Toch, Freymuth, and Petrusky report diphtheritic ulceration of the umbilicus in infants. Fleisch's case was that of an infant, 2½ months old, previously burned, who was kissed by a person suffering from diphtheria of the throat. Patterson's case concerns a young woman with a lesion on her right forefinger, who subsequently developed paralysis of all extremities. Gunther reports a case in a girl, two years old, suffering from an acute phlegmon of the abdominal wall with vesiculation resembling erysipelas. Ehrhardt reports 3 such cases without mucous membrane involvement, and 1 with subsequent throat infection. Sowade's case showed multiple ulcers on the right arm and thorax, soon after vaccination, in a child of nine months. Guthrie quotes Rosenthal, as follows, in describing the death of Griesinger: "A perityphlitic abscess had been opened, which subsequently became infected with Klebs-Löffler bacillus after it had healed. He later developed a wide-spread paralysis involving all extremities, speech, deglutition; dying on the seventieth day from respiratory paralysis." Post's case was that of an adult male, who had cared for his brother-in-law, wife and child during their illness from diphtheria. His lesion was on the foreskin, complicated with an acute phimosis, and was 4 weeks old on his entry to the hospital. A dorsal incision, having been made by his physician, was covered with the diphtheritic membrane, from which bacilli resembling morphologically the diphtheria bacillus were obtained, but not until bilateral ciliary and paralysis of all extremities had supervened. McCollom adds that several similar cases have been observed at the South Department of the Boston City Hospital, and that diphtheria of the penis is more frequent than is generally supposed. Kerr, Sack, Gerloczy, Dutschlander and Schucht have observed cases of cutaneous diphtheria unassociated with mucous membrane infection, in addition to these just referred to. There have been reported by Toch, Freymuth, Petrusky and Reichold, Veiel, Sharp and Bertelli, 5 cases of primary cutaneous diphtheria, with secondary mucous membrane infection. In Sharp's case the lesions were multiple over the chest and face, with secondary involvement of the throat; Bertelli's case, confirmed by animal inoculation, was a colleague who had a blister on the upper lip while treating a case of diphtheria of the throat; the blister became the seat of a diphtheritic infection, covered with membrane, and subsequent throat infection, which yielded promptly to antitoxin subcutaneously, without causing improve-

ment in the cutaneous lesion (to this he applied Bandis bivalent serum; the wound healed in a few days). Slater reports a case of 3 years' duration in a female, with multiple lesions on the body, probably originating in the conjunctiva, with later ear and vaginal involvement. The case had received all sorts of local treatment and had been under antisyphilitic treatment for 2 years. Finally, after careful bacteriological study, the cause was determined, and treatment by the use of antitoxin subcutaneously instituted. At the end of 5 weeks, all lesions had healed and the patient was considered cured.

CASE REPORTS

CASE I.—I wish to add the report of a male, forty-seven years old, school janitor, referred to Dr. Gibbon's service at the Jefferson Hospital by his physician, Dr. Roberts, of Llanerch, Pa. About November 12, he was helping to fumigate, and scrubbing the floor of a school then quarantined, on which a child supposed to be ill with diphtheria had vomited. During this time he suffered an abraded wound of the left middle finger on the dorsum of the second phalanx, a "blood-blister" resulting. Two days later, yellowish-gray streaks appeared about the wound, with pain, swelling and stiffness of the distal joint. On the third day, his physician incised it, applied antiseptic dressing, and later flaxseed poultices; at the end of a week, a membrane or grayish slough had appeared. Similar treatment was continued for some time at the Dispensary of the Jefferson Hospital, without improvement. He was suffering slight constitutional disturbance, vague, shifting pains over body and extremities, with loss of appetite. Two Wassermann reactions had been done and found negative. The wound at this time was covered with a dirty, yellowish-gray slough, fibrous and adherent, extending down to the extensor tendon. The edges were slightly elevated and indurated, presenting an indolent appearance, and covering all of the dorsal surface between the second and third joints (Fig. 1). At this time Dr. Rosenberger was asked to make bacteriological studies, and his report is as follows: "Inoculations were made from the wound upon agar and incubated for 24 hours at 37° C.; at the end of this time, an abundant growth developed, which was of a light lemon-yellow color; spreads made and stained with Löffler's methylene blue, and by Groves method, showed bacilli (Gram-positive) possessing the morphology of diphtheria bacilli, together with few staphylococci; a guinea-pig was inoculated with 2 c.c. of a 48 hour old bouillon culture, which was absolutely negative as to tonic effects. In bouillon, the growth was manifested by a sediment, in gelatine no liquefaction nor gas production. A vaccine was made from a 24 hour old growth upon agar, and each cubic centimetre of vaccine contained approximately 500 million bacilli; 1 c.c. of the vaccine was given at a time, and four doses were



FIG. 1.—Case I. Diphtheritic ulcer of finger.

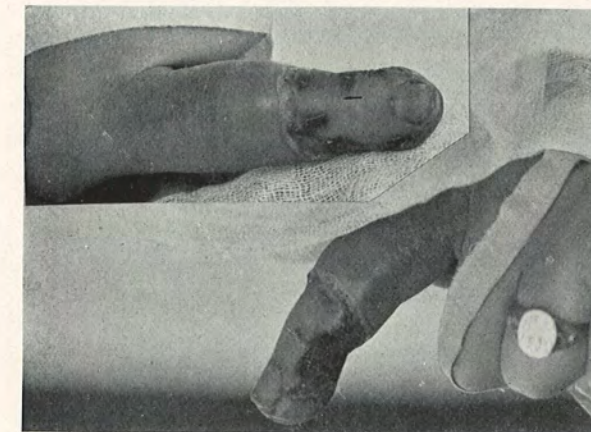


FIG. 2.—Diphtheritic ulcers of finger (condition presented in Case II).

given at four-day intervals, the patient soon began to improve and the wound healed without further trouble."

CASE II.—A girl of seventeen years, with lesion on dorsum of left index finger, almost encircling it, between second and third joints (Fig. 2), began six weeks before admission to Pennsylvania Hospital, Out-patient Department (service of Dr. Stewart), which was January 19, 1915. The trouble began with a pin-scratch; she was treated at another hospital for four weeks, and by her physician, Dr. Hickby, who referred her to the hospital, for two weeks. The wound edges were sharply defined and slightly elevated, showing some redness and induration; the surface of the wound was covered with the characteristic grayish fibrous membrane, and was difficult to remove, which exposed the extensor tendon and matrix of the nail. She had slight constitutional symptoms, with little elevation of temperature that was never recorded above 100°, and the pain seemed less than in the usual acute infection.

Bacteriological examination showed bacilli possessing the morphological characteristics of the Klebs-Löffler bacillus with a few staphylococci. The treatment consisted in the local use of diphtheria antitoxin in the form of a wet dressing on gauze covered with rubber dam to maintain moisture. This dressing was changed every 24 hours for 5 days, when the membrane had disappeared, leaving a clean granulating surface, which healed in about 4 weeks. Unfortunately, the first culture was destroyed before animal inoculation was done, and we were unable to get another after the employment of the antitoxin in spite of repeated efforts.

A summary of the review of these cases of cutaneous diphtheria would seem to show that it is usually secondary to mucous membrane diphtheria; that primary cutaneous diphtheria is an infrequent infection which may manifest itself in a single lesion, or in multiple concomitant lesions distributed over a wide area, or in the form of cutaneous and subcutaneous phlegmon, with considerable induration without marked pain, and without fluctuation or suppuration, if not complicated with pyogenic bacteria; and, finally, it may appear in the form of cellulitis with vesiculation resembling erysipelas. The infection is most apt to take place in wounds offering the most blood serum for the growth of the bacillus, as in blisters. Paralysis, as in other forms of diphtheria, is not an unusual complication, or sequel, and is usually widespread. We also find that pseudodiphtherial cutaneous infection occurs as it does on mucous membranes, and the clinical picture presented is identical with that of cutaneous diphtheria, and cannot be differentiated

except by animal inoculation. It is obvious that the clinical manifestations resulting from cutaneous infection by the diphtheria bacillus may be as diverse as the changes of environment governing the infection, which only make the appearance of the lesion or lesions more deceptive to the diagnostician. Hence the ease with which it has been mistaken for some of the syphilitic lesions, a tubercular process, a phlegmon, or some widespread skin affection. The treatment of cutaneous diphtheria resolves itself into that of diphtheria of any other part, viz.: the use of antitoxin subcutaneously or locally, or both, and for pseudodiphtherial skin infections, the use of the autogenous vaccines would seem to be the treatment of choice, and, of course, local surgical cleanliness in both conditions.

I am deeply indebted to Doctors Gibbon and Despard for the privilege of reporting the first case, and to Dr. Stewart for the privilege of reporting Case II, and to Dr. Rosenberger for his careful bacteriological study and the preparation of the vaccine in Case I.

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DR. J. STEWART RODMAN related the history of a little girl operated on three years ago at the Medico-Chirurgical Hospital for appendicitis with abscess. The wound was allowed to remain open for drainage. When drainage had about ceased and when the granulating wound was perfectly healthy, a diphtheria epidemic broke out in the children's ward. Several days after the outbreak of this epidemic a grayish membrane appeared on the granulations in the wound, which kept reforming in spite of being stripped off when the wound was dressed. Finally it occurred to some one that it would be well to have a bacteriological examination made, and there proved to be a local infection of the wound with diphtheritic infection. The child was removed to the Municipal Hospital, made a complete recovery and was subsequently operated on for ventral hernia.

ARTHROPLASTY OF THE ELBOW*

By ASTLEY PASTON COOPER ASHHURST, M.D.
OF PHILADELPHIA

I HAVE adopted arthroplasty of the elbow-joint in five patients: twice for bony ankylosis, and three times for marked limitation of motion following fracture.

TECHNIC OF THE OPERATION.—I. *Exposure of the Joint.*—The skin incision (Fig. 1)¹ begins on the external supracondylar ridge of the humerus, about 5 cm. above the joint, and is continued straight downward to the joint level where it is curved slightly backward toward the extensor surface of the forearm; its entire length is about 10 cm. This incision is carried down to the supracondylar ridge above the joint; below the joint level the deep fascia is exposed but is not incised. The soft parts are then cleared from the humerus: the brachioradialis and the extensor carpi radialis longior are displaced forward and the triceps backward, *thoroughly* exposing the external condyle, the anterior capsule of the joint, and the external lateral ligament with the origin of the extensor muscles (Fig. 2). The external condyle is then detached from the humerus by osteotome, the bone section entering the elbow-joint on the capitellar surface of the humerus. In most cases even when the ulno-humeral joint is ankylosed the radio-humeral joint is free, and the external condyle may be easily turned downward on the external lateral ligament as a hinge, exposing the joint (Fig. 3). If ankylosis is present between the radius and humerus it is easy to separate them by gouge without injury to the external lateral ligament. In order to turn the condyle downward sufficiently to expose the joint thoroughly, the capsule must be snipped with scissors in front of and behind the external lateral ligament.

2. *Dislocation of the Joint.*—If ankylosis exists between the ulna and humerus these bones are separated by a suitably shaped gouge, driven transversely across the joint by smart blows from a hammer. When the union has been almost completely divided, the remaining fibres on the inner side of the joint may be ruptured by abrupt, short, forceful movements of flexion and extension applied to the elbow-

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

¹ The accompanying illustrations (Figs. 1 to 10) are from photographs of preparations in the Laboratory of Operative Surgery in the University of Pennsylvania.

joint. If one fears injury to the ulnar nerve a small incision may be made over its course between epitrochlea and olecranon, and the nerve may be drawn away from the bones. Only in one case did I find this necessary.

Ankylosis having been overcome, or in cases where no ankylosis is present, the elbow-joint is dislocated by adducting the forearm around the internal lateral ligament, as a hinge, until the forearm lies almost parallel with the upper arm, causing the ends of the humerus, radius and ulna to come into full view (Fig. 4).

3. *Shaping the Bone Ends.*—As little as possible is done to the ulna, especially when the head of the radius is healthy. Reliance is placed on resection of the humerus for shaping the new joint (Fig. 5). If ankylosis exists in the upper radio-ulnar joint it is simpler to resect the head of the radius than to turn in a flap between radius and ulna. For shaping the humerus a Gigli wire saw mounted in a bow-shaped frame (the saw of Pierre Delbet) is the most convenient instrument; with this a series of cylindrical sections can be removed from the humerus until enough room is secured between the bone ends. Seldom is it necessary to remove any bone above the level of attachment of the internal lateral ligament at the base of the epitrochlea.

4. *Interposition of the Flap.*—The bones being temporarily restored to their normal relations, the original skin incision is extended backward from its upper end across the posterior surface of the arm (Fig. 6). The triangular skin flap thus outlined is raised, including a fair amount of subcutaneous fat, until the superficial surface of the triceps, or of the fat and fascia covering it, is fully exposed. An interposing flap of fat and fascia is then raised from the superficial surface of the triceps, with its base at the olecranon (Fig. 7). It is best to include some of the triceps aponeurosis and muscular fibres in this flap. The elbow-joint is then partially dislocated again, and the flap is attached to the internal lateral ligament of the elbow, and to the anterior and posterior capsules of the joint, by a few interrupted sutures of chromicized catgut (No. 0), thoroughly covering the articular surface of the humerus (Fig. 8).

5. *Closure of the Wound.*—The forearm is restored to its normal relation with the arm, and the external condyle is brought up in front of the pedicle of the interposing flap, and is fixed to the humerus (Fig. 9). For this purpose I prefer Lambotte's self-boring screws; in the accompanying illustration a nail was employed because at the time (in the Laboratory of Operative Surgery) no such screws were at hand. I have also used chromic gut and phosphor bronze wire

sutures, but have found them inferior to the Lambotte screws in obtaining secure fixation. Two screws are better than one. If much bone has been removed from the humerus, it will be necessary to trim the external condyle to fit.

The triceps is then sutured accurately to the brachioradialis and extensor muscles, the deep and superficial fasciæ are accurately approximated, and finally the skin wound is closed (Fig. 10). No drainage is necessary. Interrupted chromic gut sutures (No. 1 or No. 2) are employed throughout. Rarely is a single ligature required.

The average time I have consumed in the operation is about one hour and thirty minutes.

CASE HISTORIES

CASE I.—*Malunion of fracture of external condyle; limited motion and cubitus varus.* James W., aged five years. Treated in Dr. Frazier's service at the Episcopal Hospital. Fractured the external condyle of his right humerus in July, 1908; and first came under my care in October, 1908, for limited motion (50 to 145 degrees) and cubitus varus (200 degrees). A skiagraph showed a fracture with outward rotation of the external condyle, but bony union. For six weeks subsequently light massage and passive movements were employed, but the range of motion improved only 10 degrees in flexion (40 to 145 degrees). Fig. 11 gives a photograph taken before operation.

Operation (November 18, 1908).—Usual external incision. Enough of the external condyle was removed (without detaching it from the humerus) to permit full extension of the elbow, as well as to overcome the cubitus varus. The olecranon fossa on the posterior surface of the humerus was also deepened. A fatty fascial flap from the superficial surface of the triceps was turned in over the denuded external condyle and the wound closed. The elbow was dressed in hyperflexion.

At the first dressing, ten days later, the wound was healed and the skin sutures absorbed. Motion was free and painless from 45 to 90 degrees. The arm was now carried in a sling. On December 5 there was motion from 40 to 140 degrees.

In May, 1912, three years and a half after operation, the boy was presented at a meeting of the Philadelphia Academy of Surgery, exhibiting perfect function, no varus deformity, full flexion, but extension only to 150 degrees (ANNALS OF SURGERY, 1912, ii, 647). Fig. 11 shows photographs made in March, 1915, more than six years since operation.

CASE II.—*Malunion of fracture of lower end of humerus; limited motion and cubitus varus.* William G., aged eighteen years.

Treated in Dr. Harte's service at the Orthopædic Hospital. Referred by Dr. E. H. Kistler, of Lansford, Pa. When three years old this boy had fallen out of bed, landing on his left elbow. He recovered with Volkmann's contracture of the forearm, cubitus varus, and limited motion in the joint (40 to 110 degrees). When first seen, August, 1912, the Volkmann's contracture caused him no inconvenience, but the limited extension in the elbow was a serious handicap in his work in the mines, and his elbow was weak from the varus deformity and pained him if he used it much. Photographs made before operation (Fig. 12) show the distortion of the bony points at the elbow and the limit of extension (× indicates head of radius; the condyles and the olecranon are indicated by dots).

Operation (September 2, 1912).—Through the usual external incision the head of the radius, which projected far backward (Fig. 13), was exposed posterior to the external lateral ligament, and was excised. The external condyle was then detached, the joint luxated, and a curved section was removed from the humerus, with Butcher's saw, much more bone being removed from the radial than from the ulnar side of the humerus, so as to overcome the varus deformity. Fig. 14 shows the portions of bone removed, that from the humerus having been removed in three sections, until the sawn surface fitted the ulna and the varus deformity was abolished. A flap of aponeurosis and muscle was secured from the triceps in the usual way. The epicondyle was re-attached to the shaft of the humerus with chromic gut. A drainage tube was placed at each end of the incision. The tubes were removed after three days. It was not necessary to have employed them. The arm was dressed on a straight anterior splint, at an angle of 160 degrees.

September 5: Motion from 90 to 135 degrees is easy.

September 19: Out-patient. Sinuses (resulting from unnecessary use of drainage tubes) have healed. Motion 90 to 160 degrees is easy. He carries his arm in a sling.

October 3: Motion 65 to 135 degrees. Ordered massage and light passive movements three times weekly.

October 17: Treatment discontinued. Motion 65 to 160 degrees. Returns to work.

July 31, 1913: Eleven months after operation the patient was again photographed (Fig. 12), to show the range of motion (40 to 170 degrees). There was no cubitus varus and perfect function. The elbow is stable. He works on a breaker engine at the mines.

CASE III.—*Bony ankylosis from metastatic arthritis.* Gertrude T., aged twenty-three years. Treated in Dr. Harte's service

at the Orthopædic Hospital. In May, 1912, when about seven months pregnant, but without any evident cause (such as preceding tonsillitis, influenza, vaginitis, etc.) this patient developed an acute polyarthritis and was confined to bed for seven weeks. The pregnancy terminated normally after convalescence, but the left elbow and right knee were ankylosed. When first seen at the Orthopædic Hospital, in March, 1913, about ten months after this attack of arthritis, the elbow was fixed in bony ankylosis at an angle of 110 degrees; fortunately the radio-humeral joint and the upper radio-ulnar joint were not involved, as rotation in the forearm was normal.

Operation (May 1, 1913).—Arthroplasty of elbow by usual technic. A small incision was also made over the ulnar nerve and this was drawn away from the internal condyle until the bone ends were properly shaped. Flap obtained from triceps as usual, and epicondyle reattached to humerus by wire suture. No drain. Dressed on internal right-angled splint.

May 12: First dressing. Inner incision healed; outer incision healed all but one spot, between two sutures at upper end, over the cavity resulting from cutting the triceps flap. A little serous ooze occurred at this point. Motion of 30 degrees free and painless. Can get hand to mouth. Arm carried in sling.

May 15: Motion from 70 to 120 degrees without pain. Rotation in forearm normal. Can put hand to back of neck.

May 23: Passive motion from 65 to 160 degrees without pain. Active movement from 70 to 120 degrees. Arthroplasty of the knee was done to-day (*Trans. Coll. Phys. Phila.*, 1914, xxxvi, 236), and on this account the patient had to remain in the hospital longer. Fig. 15 shows the condition on admission, and Figs. 16 and 17 show respectively the limits of flexion and of extension in elbow and knee three months after operation. Figs. 18 and 19 are from skiagraphs made before and after arthroplasty of the elbow.

October 17, 1914: Eighteen months after operation there was motion in the elbow from 45 to 150 degrees, there was active power of extension in the triceps, and the joint was quite stable. She does all her own housework, and finds it a very useful arm.

CASE IV.—Malunion of fracture of lower end of humerus, with limited motion. Benjamin F., aged fourteen years. Treated in Dr. Ashhurst's Orthopædic Service at the Episcopal Hospital. In the summer of 1912 this boy fell on his elbow and sustained a fracture-dislocation of the type Posadas (diacondylar fracture of the humerus with forward displacement of the lower fragment and posterior dislocation of both bones of the forearm). Neither the fragments of the humerus nor the dislocation of the elbow had been reduced, and 16 months later the boy applied to the



FIG. 1.—Arthroplasty of elbow; skin incision.

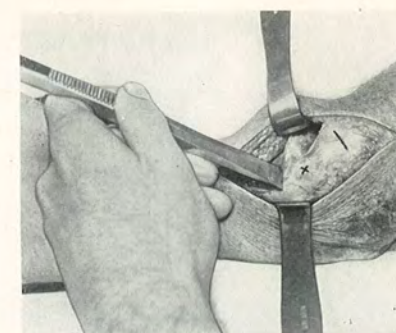


FIG. 2.—Arthroplasty of elbow; external condyle (X) and head of radius (—) exposed, and osteotome applied to external condyle.

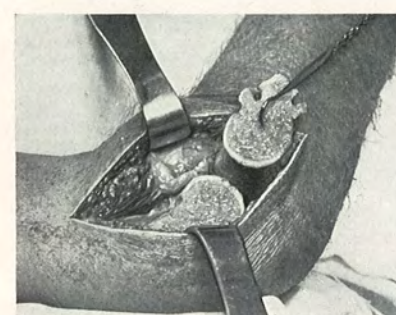


FIG. 3.—Arthroplasty of elbow; external condyle turned down, exposing joint.

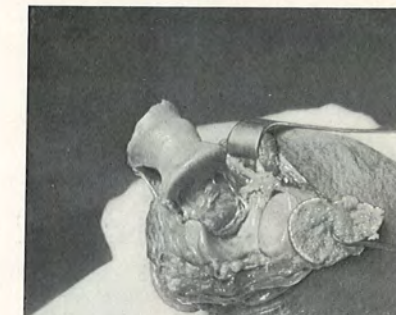


FIG. 4.—Arthroplasty of elbow; joint luxated around internal lateral ligament as a hinge.

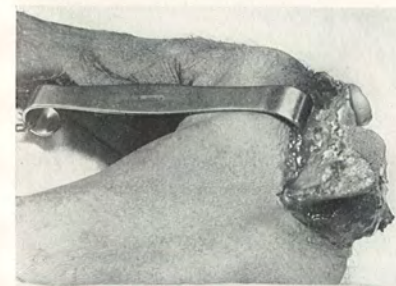


FIG. 5.—Arthroplasty of elbow; articulating surface of humerus removed with saw. Joint is viewed from outer side; the external supracondylar ridge and the surface from which the external condyle has been detached face the reader, and the joint surface of the humerus (freshly sawn) is directed toward the right of the picture.

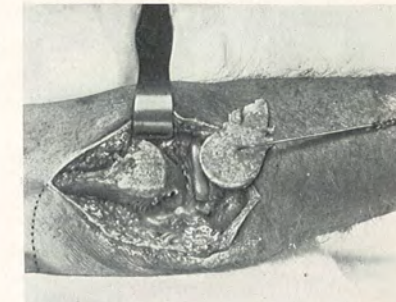


FIG. 6.—Arthroplasty of elbow; bones replaced; dotted line indicates extension of primary skin incision, to expose triceps.

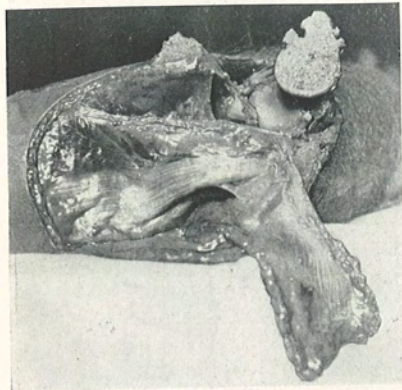


FIG. 7.—Arthroplasty of elbow; fat and fascia pedicled flap cut from surface of triceps.

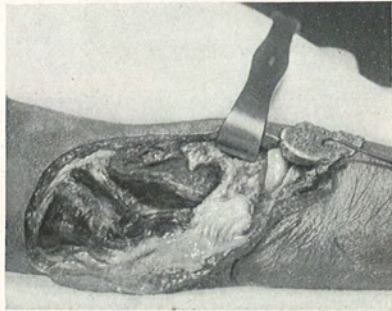


FIG. 8.—Arthroplasty of elbow; flap turned into joint covering articular surface of humerus. Same view of joint as Fig. 6.

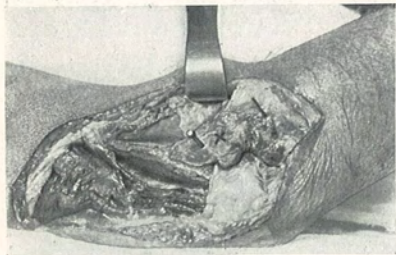


FIG. 9.—Arthroplasty of elbow; external condyle has been replaced and fastened by a screw or nail.

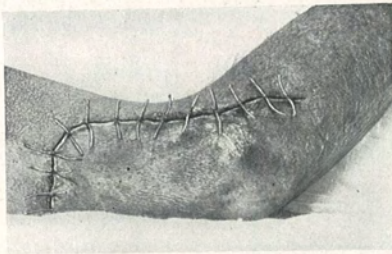


FIG. 10.—Arthroplasty of elbow; skin sutured.

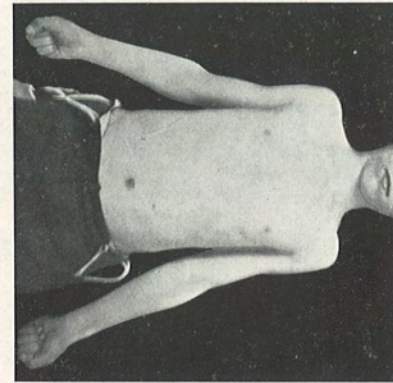
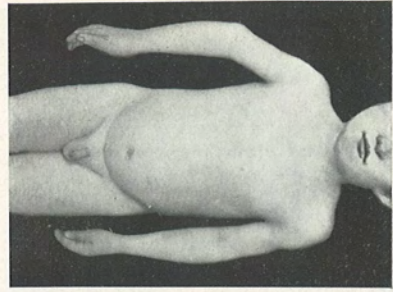


FIG. 11.—Case I. A is a photograph taken in 1908, just before operation, showing cubitus varus. B and C are photographs taken in 1913, showing restoration of carrying angle and limits of extension and flexion.

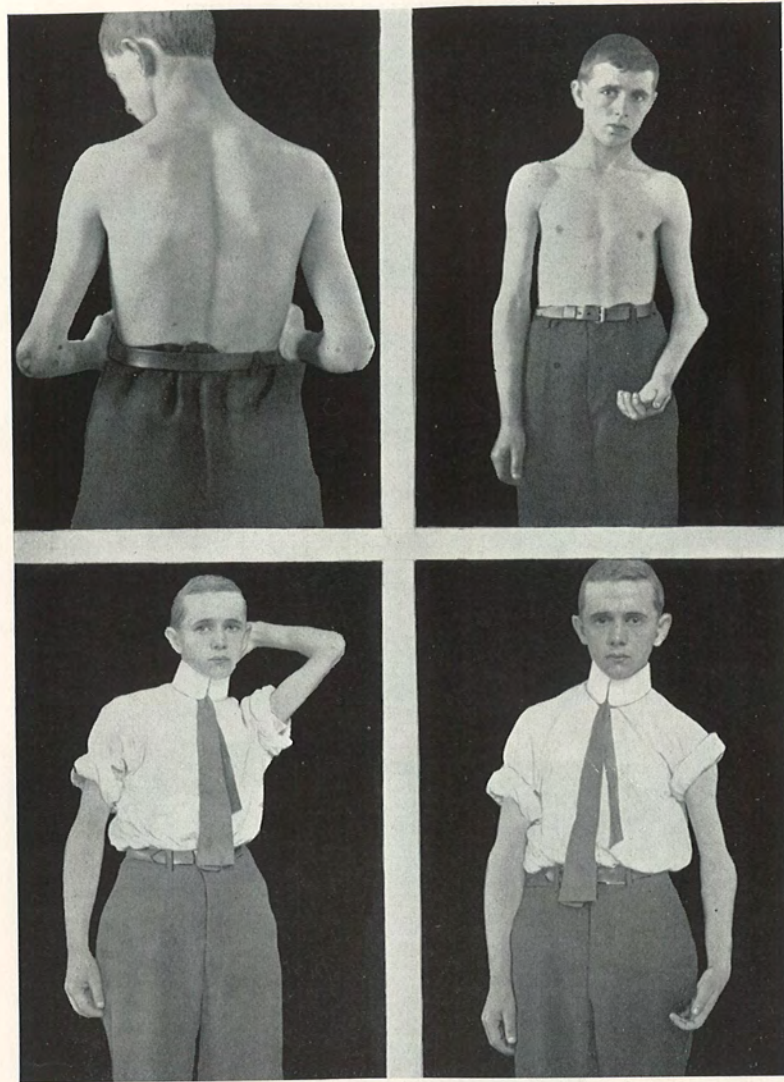


FIG. 12.—Case II. The first two photographs were made before operation, showing distortion of bony landmarks (X indicates head of radius) and limit of extension. The other two photographs were made eleven months after operation, showing range of flexion and extension, and restoration of carrying angle.

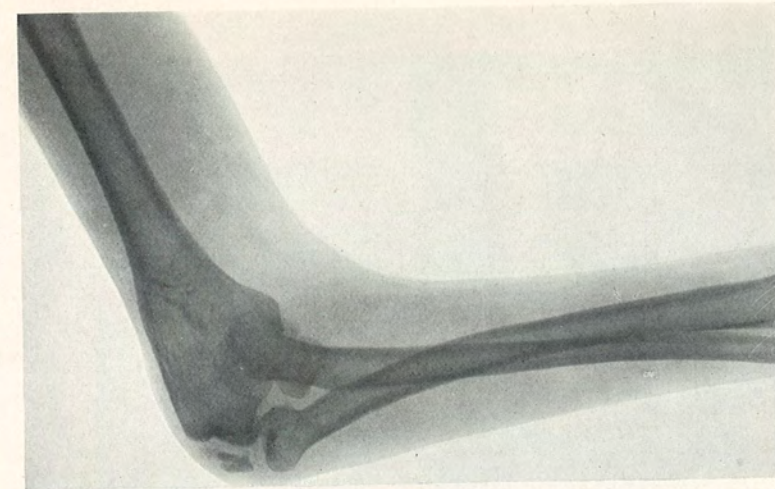


FIG. 13.—Case II. Skiagraph before operation, showing marked cubitus varus and limitation of extension.

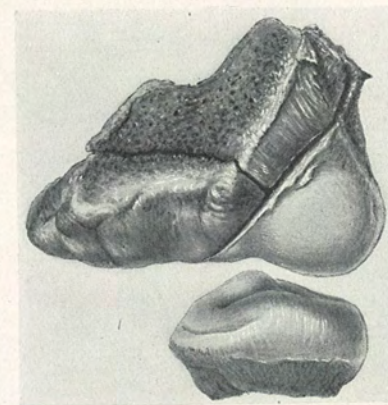


FIG. 14.—Case II. Arthroplasty of elbow; portions of humerus and head of radius excised (September, 1912).



FIG. 15.—Condition of Case III on admission.

FIG. 16.—Showing amount of possible flexion in Case III on discharge.

FIG. 17.—Showing amount of extension possible in Case III on discharge.

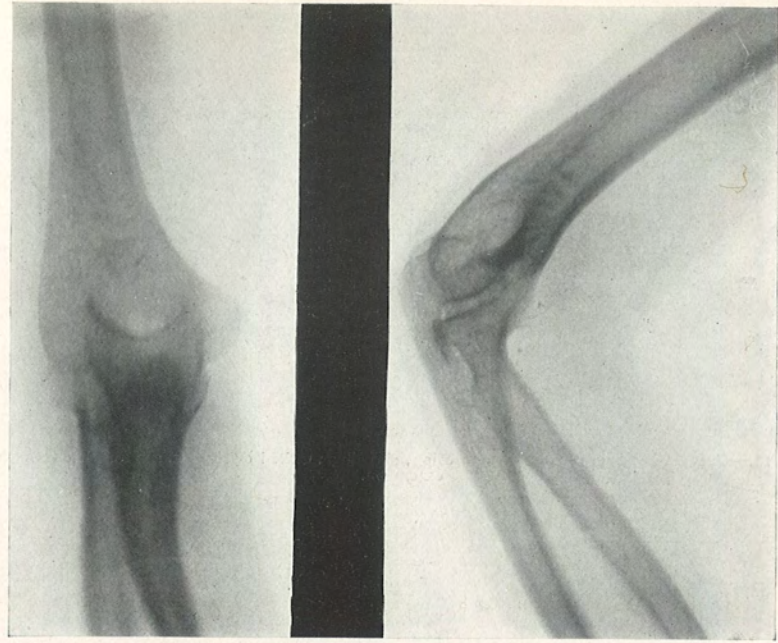


FIG. 18.—Case III. Skiagraphs showing ankylosis of elbow before arthroplasty.



FIG. 19.—Case III. Result of arthroplasty. From skiagraph seven weeks after operation.

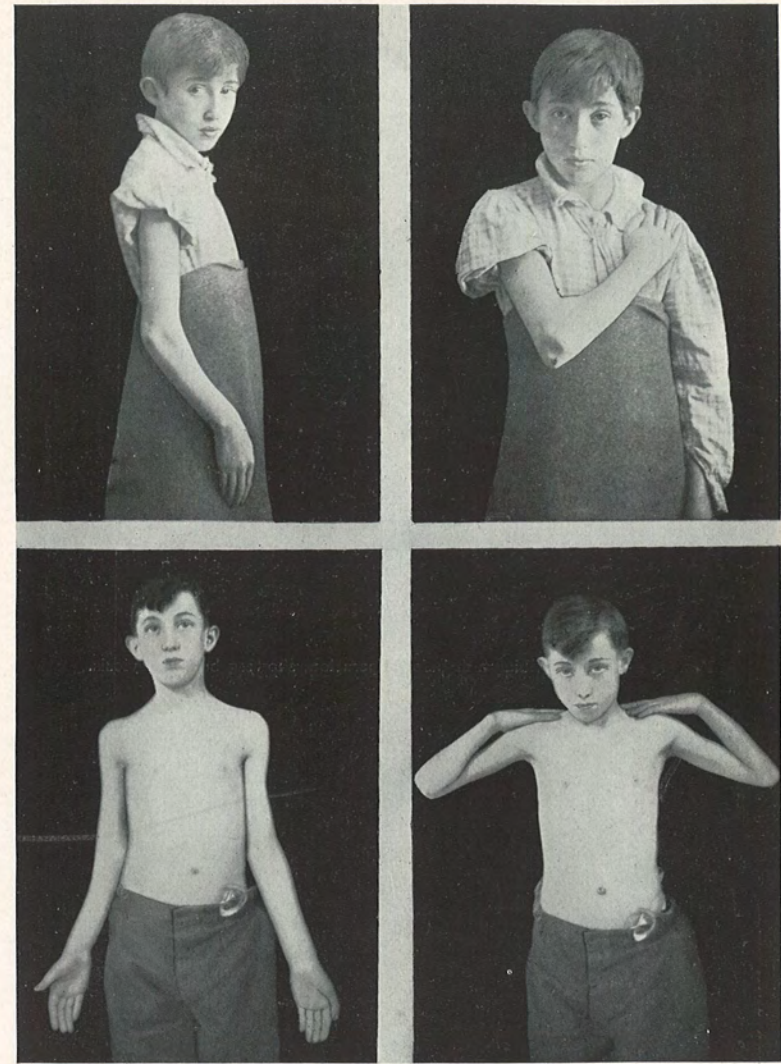


FIG. 20.—Case IV. Upper photographs show limits of extension and flexion before operation. Lower photographs were made five months after operation, showing results of arthroplasty.



FIG. 21.—Case V. Skiagraph before operation, showing bony ankylosis.



FIG. 22.—Case V. Skiagraph six weeks after arthroplasty.

orthopædic department for disability from limited flexion and extension (65 to 150 degrees) (Fig. 20).

Operation (November 26, 1913).—Arthroplasty by the usual technic. After trimming the end of the humerus to proper shape with the bow-saw, it was found the ulna tended to stay in posterior luxation; so the olecranon was removed, preserving the periosteal attachments of the triceps. The radial head and the greater sigmoid cavity of the ulna were not disturbed. A flap from the triceps was inverted as usual, and the epicondyle was re-attached by chromic-gut sutures. No drain. Dressed on internal right-angled splint.

November 29: Discharged from ward. Skiagraph shows subluxation backward of radius and ulna.

December 1: Out-patient. First dressing; some sloughing of edges of skin flap turned back to expose triceps. Wound is clean. Elbow dressed in hyperflexion.

December 15: Skin granulating well. Free motion from hyperflexion to right angle. Arm in sling.

December 22: Motion 45 to 120 degrees. Out of sling.

January 5, 1914: Incision healed. Motion 40 to 145 degrees.

January 12: Motion 40 to 150 degrees.

January 19: Motion 40 to 160 degrees.

March 9: Motion 10 to 160 degrees.

April 27: Five months after operation (Fig. 20). Motion 10 to 180 degrees. In full extension radius and ulna luxate backward. There is free lateral motion in elbow, though external condyle is firmly attached to the humerus. Very slight power of extension in elbow, good power in flexion.

June 29: Seven months after operation. Can chop wood holding axe in both hands, indicating a considerable improvement in the stability of the elbow.

CASE V.—*Bony ankylosis of elbow from septic arthritis.* Sarah M., aged twenty-seven years. Dr. Ashhurst's service at Episcopal Hospital (orthopædic). In December, 1913, this patient suffered from a "heavy cold" with cough; she was in the habit of carrying her eighteen months' old baby on her left arm, which gradually became stiff and painful. In less than a week matter formed, and an abscess on the inner side of the joint was lanced by her family physician. She was admitted to Dr. Frazier's service in the Episcopal Hospital on January 8, 1914, and on January 20 Dr. Frazier opened the sinuses more freely and put in drainage tubes. Cultures of pus at this time gave a pure growth of streptococcus pyogenes. The elbow became stiff. She went home in the end of February, and the sinuses were all healed early in March, 1914. Since then there has been no pain or tenderness.

Examination in May, 1914, showed ulno-humeral ankylosis at an angle of 110 degrees. She could not get her hand to her mouth, nor even to the top of her head. Rotation in the forearm was about half normal, supination being lost. Fig. 21 is from a skiagraph before operation.

Operation (May 30, 1914).—Arthroplasty by the usual technic. All told, sections about 0.5 cm. in thickness were removed from the humerus by the mounted Gigli saw. A flap from the triceps was interposed, and the external condyle re-attached by a screw. No drain. Dressed on internal right-angled splint.

June 6: First dressing. Wound healed. Can put hand to face with ease.

June 8: Went home.

June 15: Out-patient. Motion 70 to 100 degrees. Massage ordered.

July 13: Motion 85 to 110 degrees causes pain at limits named.

August 31: Free and easy motion 90 to 120 degrees. Rotation normal. Refuses to have forceful motion under an anæsthetic. Fig. 22 is from a skiagraph made six weeks after operation.

SUMMARY OF RESULTS IN FIVE CASES OF ARTHROPLASTY OF ELBOW

Case	Before Operation			After Operation		
	Flexion	Extension	Deformity	Flexion	Extension	Deformity
I	40°	145°	Varus	35°	150°	None
II	40°	110°	Varus	40°	170°	None
III	110°	110°	Ankylosis	45°	150°	None
IV	65°	150°	Posterior dislocation	10°	180°	Posterior dislocation (only in extension)
V	110°	110°	Ankylosis	90°	120°	None

DR. GWILYM G. DAVIS said that the results obtained by Dr. Ashhurst show that arthroplasty in this joint is more satisfactory than in most others. This accorded with his own experience. It would seem, therefore, that surgeons are justified in carrying out more radical procedures in cases with limitation of motion in the elbow than in joints of the lower extremities in which weight-bearing tends to detract from the good results. The question arises of the necessity of retaining the lateral ligaments. In the majority of his own cases he had not retained these ligaments. Instead of making one large flap he had made two, taking one flap from each side. One of the difficulties of the operation is shown in one of his cases in which there was some trouble with the vitality of the flap. This is a serious difficulty in arthro-

plastics, especially of the knee. The necessity of using in the arm flaps from other parts of the body, like the fascia lata, is not so urgent as in the knee and hip. While very fair results can be obtained by ordinary resection, this resection without the interposition of flaps necessitates the removal of one to one and a half inches of bone to insure movement. When an arthroplasty is done only sufficient bone to allow interposition of the flaps needs to be removed, and this is less than half the amount necessarily removed in an ordinary resection. The arthroplasty, even without the retention of lateral ligaments, if there is no mishap, is almost certain to give a stable joint.

THE OPERATIVE TREATMENT OF FRACTURES OF THE FEMUR, HUMERUS, AND TIBIA

DR. GEORGE P. MÜLLER presented lantern slides illustrating his subject.

NOTES ON FRACTURES*

By WILLIAM J. RYAN, M.D.
OF PHILADELPHIA, PA.

THE following report is based on the "follow-up" records of 121 fractures treated in the Surgical Dispensary of the St. Agnes' Hospital, of Philadelphia, from February 1, 1914, to August 1, 1914, and in Dr. Müller's Clinic in the Polyclinic Hospital during 1914.

Seventy-four patients were traced, and, while we were disappointed in the limited scope of the investigation, certain details seem of interest.

	Total cases	Traced
Nose	3	0
Inferior maxilla	4	1
Zygoma	1	0
Ribs	6	3
Clavicle	10	6
Acromial process	1	0
Humerus	18	13
Radius	31	23
Ulna	7	4
Radius and ulna	6	4
Metacarpal	10	7
Phalanges of finger	6	3
Tibia	7	4
Fibula	7	4
Metatarsal	4	2
Total	121	74

One fracture of the inferior maxilla was heard from. This case had no disability or deformity but complained of occasional slight pain when exposed to cold.

Of 3 fractures of the ribs traced, 1 had died of pneumonia, and 2 had had pleurisy. They were all men over fifty. The pneumonia case died out of town and we could get no definite information regarding his illness. One of the cases of pleurisy was on the affected side. Examination a year after the injury revealed no deformity along the line of the fractured ribs.

Six cases of fractured clavicle heard from showed excellent functional results. Two of them, of twenty and thirty years of age, showed considerable callus formation. Fortunately, both were men.

Thirteen fractures of the humerus were traced; 2 of the upper end; 2 of the shaft; and 9 of the lower end. The first were both

* Read before the Philadelphia Academy of Surgery, April 5, 1915.

impacted fractures of the surgical neck. One man of forty-five, a bookbinder, is back at his regular employment. The other, a man of seventy-four, has good firm union but has considerable pain on forced flexion and internal rotation. Of the shaft fractures, 1, a four-year-old girl with a fracture below the insertion of the deltoid, has a perfect result, both anatomically and functionally. A man who had an oblique fracture at the middle of the shaft with 1 inch shortening has some bowing backward of the humerus, but no shortening, and the functional result is excellent. Nine fractures of the lower end were seen or heard from; 2 of the internal condyle; 5 of the external condyle; and 2 supracondylar. All were in children and all were due to falls on the elbow which makes the greater frequency of the fractures of the external condyle rather extraordinary. These were uncomplicated and all had good results. One supracondylar fracture has limitation of extension, but flexion is as good as in the other arm. This supracondylar fracture was accompanied by a fracture of both external and internal condyles, the line of fracture of both condyles converging as they extended downward. There was extreme swelling and extensive bleb formation, which delayed active treatment of the fracture for four days.

Radius.—Of 31 fractures of the radius, 23 were traced. These involved the upper end once, the shaft 4 times, and the lower end 18 times. The fracture of the upper end was a chip off the flange-like head. The case was a week old with a history of a fall on the hand which caused the elbow to bend, and the back of the forearm came in contact with the ground. Jones's position gave an excellent result, there being no impairment of motion in the elbow, nor interference with pronation and supination.

Four fractures of the shaft were traced, 3 being transverse cracks without displacement, and 1 oblique fracture about 4 inches from the lower end of the radius. The obliquity was from behind downward and forward. The functional result in this case was only fair, there being some interference with supination six months after the injury, due to failure of the patient to keep up his massage treatment. He returned again for massage and now has almost complete power of supination.

Eighteen of 23 fractures of the lower end were traced. Sixteen were within 1½ inches of the lower end, and 2 were fractures of the anterior edge of the articulating surface. Seven of the 23 fractures showed the classical silver fork deformity, the latter varying in degree. All 7 were accompanied by a fracture of the styloid process of the ulna. These were treated with anterior and posterior straight splints,

the posterior being notched to keep from pressing on the prominent lower end of the ulna. All gave good functional results, but in all 7 there was a loss of the prominence of the lower end of the ulna. This alteration was not present in the following 9 cases, which were treated with a Bond splint. Seven were transverse fractures of the radius with little or no displacement, and 2 were epiphyseal separations. All have good functional and anatomical results.

I might remark here that 3 cases of this year's series with marked deformity and accompanied by fracture of the styloid of the ulna were treated with a Bond splint and, six weeks to two months after the injury, show no loss of prominence of the lower end of the ulna.

The two Barton's fractures were treated with anterior straight splint and have good functional results.

Ulna.—Of the 7 fractures of the ulna, 4 were traced; 2 of the olecranon, 1 of the shaft at the junction of the lower and middle third, and 1 of the styloid. All were simple and showed good results.

Radius and Ulna.—Four out of 6 were traced. Two were complete of both bones, with considerable displacement; 1 a girl eight years of age and 1 a woman of forty. One was greenstick of both bones, and 1 was a complete fracture of the radius with a greenstick of the ulna, the type reported by Dr. Skillern before this Academy last year.

The fracture in the young girl was difficult of reduction because both lower fragments were split longitudinally about 1 inch, and the upper fragments wedged loosely in the split, the fracture occurring about 3 inches above the wrist. It was successfully reduced though and she has a good result both functionally and anatomically.

The result of the fracture in the woman is bad. She was struck on the back of the arm by a heavy poker, and on admission her forearm was sharply angulated at the junction of the lower and middle third. X-ray showed both lower fragments to be badly comminuted with encroachment by the radial fragments on the interosseous space. Plating was advised, but she refused, and we attempted to mould the fragments into position without much success. She has fairly good motion in her wrist but she can not completely close her fingers. Pronation and supination are also limited. There is slight bowing backward of both bones.

The greenstick fracture of both bones was simple and gave a good result. The case of Skillern's fracture has an excellent result. At the time of admission there was some backward angulation but we were able to reduce it without making the greenstick fracture of the ulna complete. All these cases were treated in full supination.

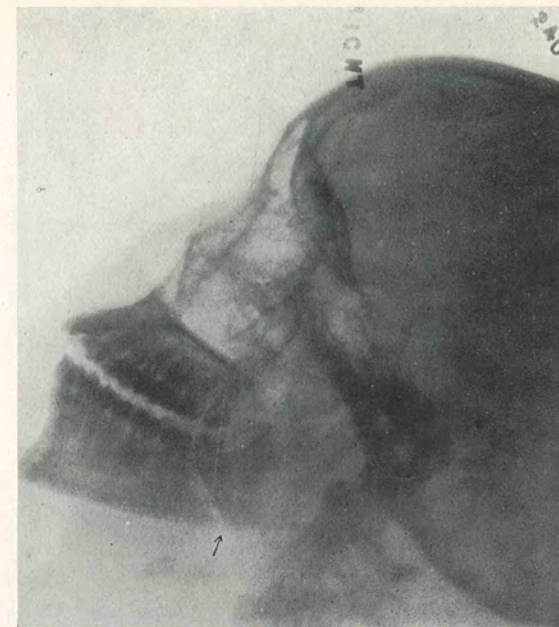


FIG. 1.—Fracture of jaw, of three months' duration before treated. Anatomical and functional results good. Some pain in damp weather.

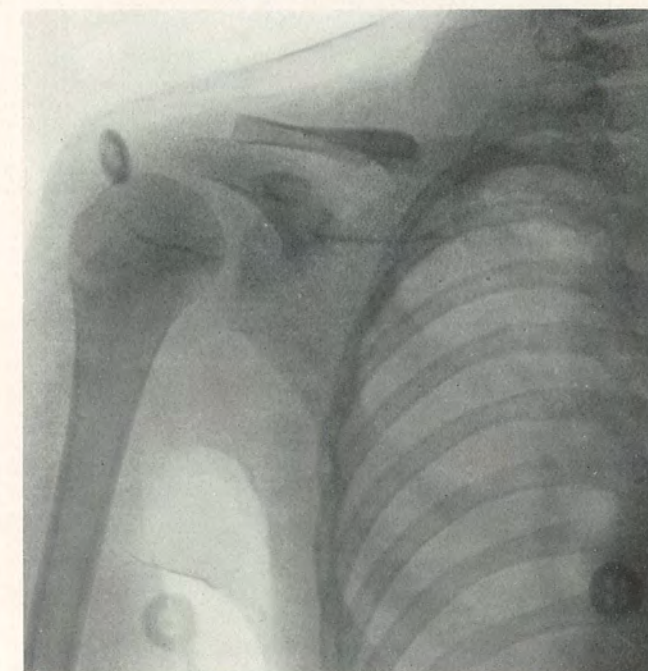


FIG. 2.—Fracture of middle of clavicle. Three weeks old on admission.



FIG. 3.—Male patient, aged seventy-eight. Fracture of upper end of humerus and surgical neck; fracture of head including greater tuberosity. Result: good union; fair function; pain on extreme flexion and extension.

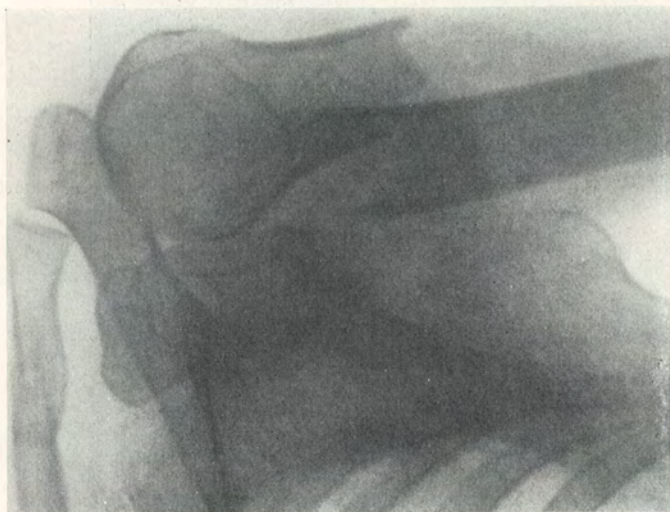


FIG. 4.—Fracture of upper end of shaft of humerus. Excellent result both anatomically and functionally.

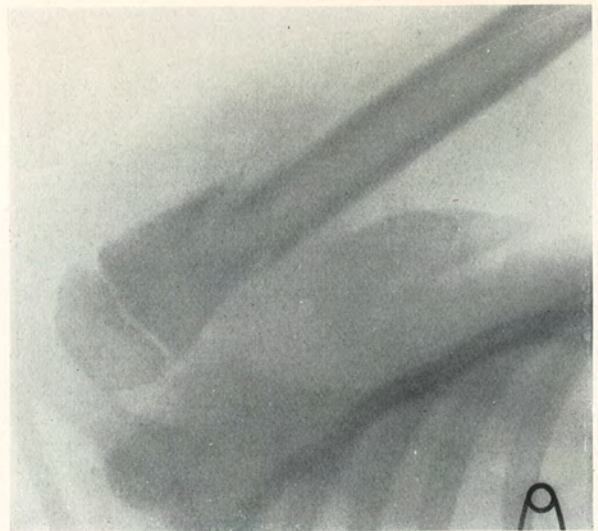


FIG. 5.—Fracture of surgical neck of humerus. Anatomical and functional results excellent.

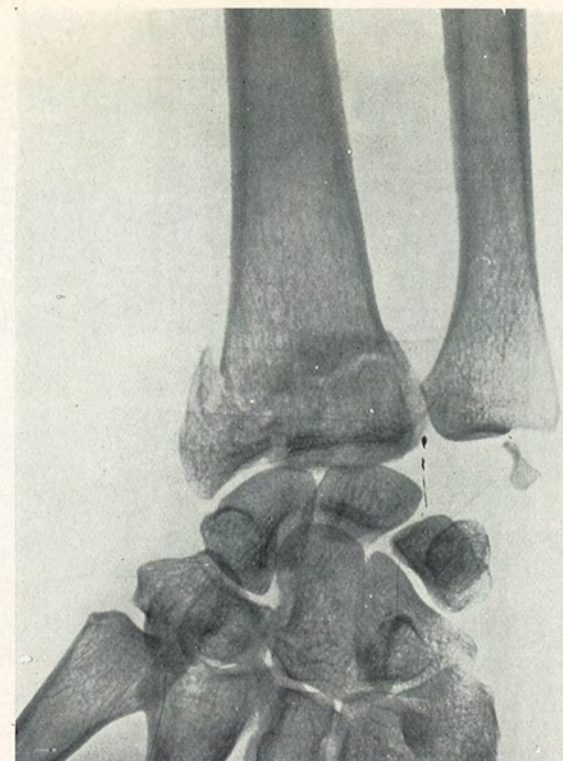


FIG. 6.—Fracture of lower end of radius; comminuted fracture of styloid of ulna. Anatomical result: slight bulging in front of wrist; functional result good.

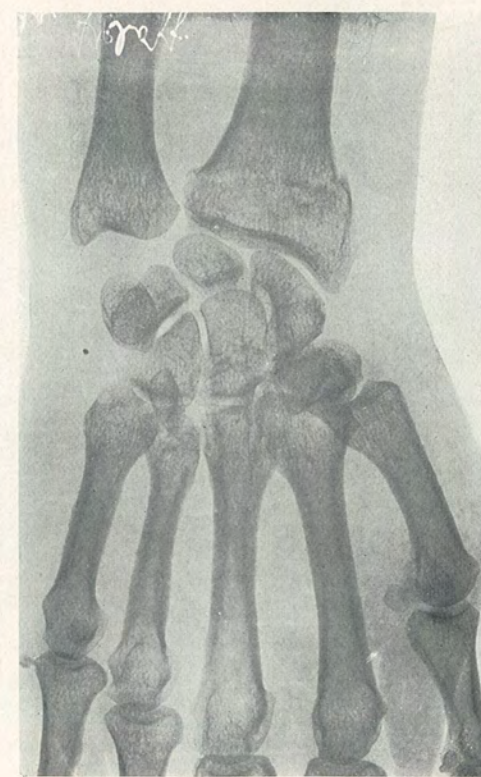


FIG. 7.—Impacted fracture of lower end of radius.

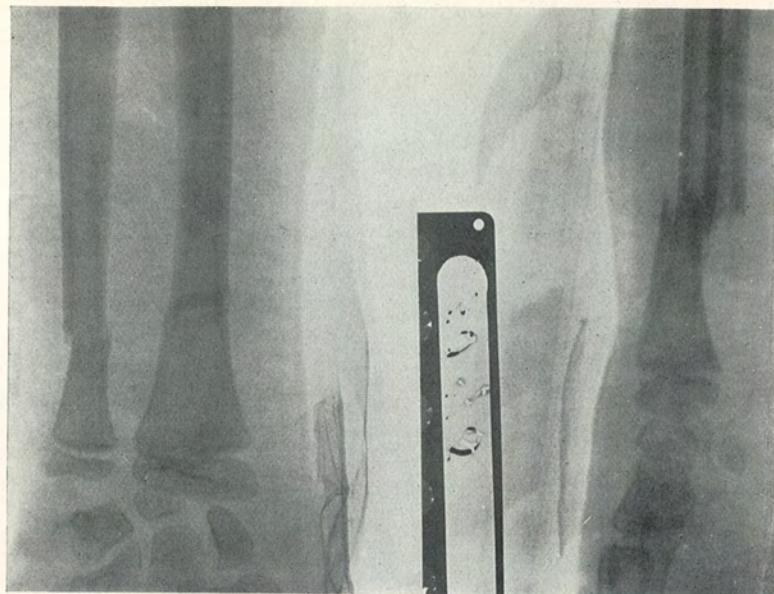


FIG. 8.—While playing, fell from top step, striking pavement with hand outstretched. Examination disclosed backward bending of forearm about two inches above wrist. Anterior and posterior straight splints in position midway between pronation and supination. This plate taken after first attempt at reduction. This plate illustrates the case in which the upper fragments were split and in which the upper ends of lower fragments were caught in the split. See text, page 295.

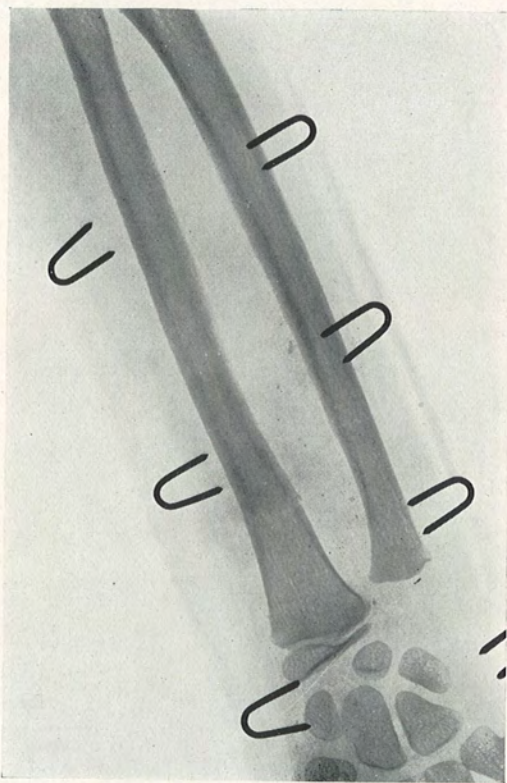


FIG. 9.—Greenstick fracture of both bones of the forearm. Result excellent.

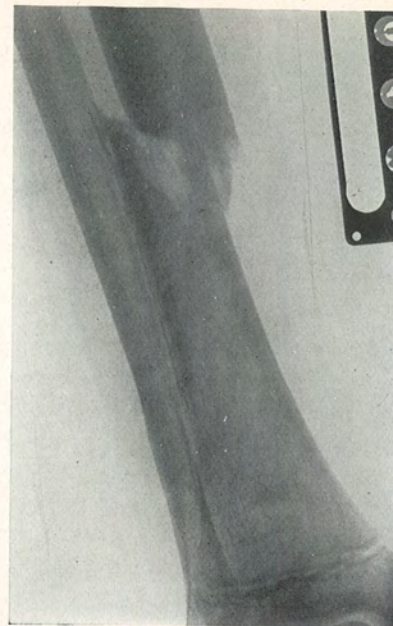


FIG. 10.—Fracture of shaft of tibia, treated by extension and plaster cast. Anatomical result: slight prominence of lower end anteriorly; functional result excellent.



FIG. 11.—Fracture of both bones of the leg; considerable comminution. Functional result fair, there being some stiffness of flexion.



FIG. 12.—Comminuted fracture of lower end of fibula.



FIG. 13.—Comminuted fracture of first metatarsal with fracture of proximal phalanges of first and second toes.

Metacarpal.—Seven cases were heard from; 1 of the first, 4 of the second, and 2 of the fifth. All were accompanied by great swelling. The fracture of the first involved the head and extended into the joint. Dressing in full abduction and early massage gave a good result. The other 6 were simple without displacement and have excellent results.

Fractures of the phalanges were simple and uncomplicated and need only be mentioned.

Tibia.—Four cases of fracture of the tibia were heard from. One of these cases was very interesting. The patient was a boy, ten years of age, who while running struck his leg against a sharp spike of an iron fence which had been bent outward towards the sidewalk. Close examination of the lacerated wound showed that a groove had been made in the antero-external surface of the tibia about $\frac{1}{4}$ inch deep and about 1 inch long. There was no evidence of other fracture and a careful röntgenogram showed no fracture other than the groove. The other 3 cases were in children: 2 greenstick and 1 spiral fracture which was easily reduced. Plaster cast was used in these 3 and they have excellent results, all being able to run and play as before.

Fibula.—Of 7 fractures of the fibula 4 were heard from. Three were Pott's fractures without involvement of the internal malleolus. Two were treated in the house in the usual manner and discharged in a week to return to the surgical dispensary. One was ten days old on admission and a plaster cast was applied in dispensary. The fourth case was at the junction of the upper and middle thirds and was caused by the kick of a horse. There was displacement backward of the lower fragment about $\frac{1}{2}$ inch. After reduction a plaster cast was applied from the toes to the middle of the thigh. This man has now a hypertrophic arthritis of the knee of the injured leg, though X-ray at the time of injury showed nothing abnormal in the knee.

Metatarsal.—Two fractures of the first metatarsal were heard from. Both were in the middle of the bone and were due to the fall of a heavy weight on the foot. One was accompanied by a fracture of the first and second proximal phalanges. It was greatly comminuted, the bone really being smashed; the other, by the first and second proximal and the third distal phalanx. In both there was entrance swelling and ecchymosis which required small incision. In first no displacement occurred. In the second there was angulation toward palmar surface. Both cases were treated with a moulded binder's board splint and a wide bandage over instep. (The functional result of the first is good, but the other case has to wear an arch support to relieve pain.)