STENOSING TENDOVAGINITIS AT THE RADIAL STYLOID PROCESS

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In 1895 de Quervain described a previously unrecognized condition affecting the tendon sheath of the abductor longus and extensor brevis pollicis tendons, which occupies the first compartment on the dorsal surface of the radius, near the styloid process. This condition was characterized by definite symptoms and physical signs and responded readily to appropriate treatment. Subsequently a number of articles along similar lines appeared in the foreign journals. Strange to say, scant recognition has been accorded this subject in the American literature. The only references to stenosing tendovaginitis in this country are the following: In March, 1927, five cases from the writer's service at the Hospital for Joint Diseases were shown at a meeting of the Orthopaedic Section of the New York Academy of Medicine by Dr. H. C. Stein and reported under the Transactions of the Section in the American Journal of Surgery, July, 1927 (III, 77). More recently an article entitled, "Stenosing Fibrous Tendovaginitis over the Radial Styloid (de Quervain)" by Dr. C. C. Schneider, Milwaukee, Wisconsin, appeared in the June, 1928 (XLVI, 846), issue of Surgery, Gynecology and Obstetrics.

The fact that so few reports on stenosing tendovaginitis appear in the American literature does not mean that the condition is uncommon in our country, for during the period between 1926–1928 twenty-four cases were operated upon for this lesion at our institution*. This condition is apt to be erroneously diagnosed as rheumatism, neuritis, periostitis, tenosynovitis and even tuberculous osteitis.

The pathological changes are not widely understood, the treatment of the condition was often irrational and unsuccessful. Stenosing tendovaginitis, unless properly diagnosed and treated, is progressive and tends towards chronicity. It is not only painful but at times disabling, and because it is generally seen in the working classes it may seriously affect the economic status of the patient. It is hoped, therefore, that a deeper and a more comprehensive knowledge of the various factors which constitute the disease process will facilitate its diagnosis.

REVIEW OF THE LITERATURE

De Quervain in his original contribution reported five cases. All were females; their ages varied between twenty-five and fifty-five. Their

*Eight additional cases have been operated upon since the completion of the above article.
complaints were strikingly similar, consisting of pain at the radial styloid process radiating down the thumb and up the forearm, slight swelling in the region of the tendon sheath, pain on movements of the thumb and wrist, and inability to firmly grasp objects. Conservative treatment,—such as baking, massage, rest and immobilization, failed to relieve the symptoms. Two cases at operation showed fibrous thickening of the tendon sheath fascia, which caused constriction of the enclosed tendons. On incising this tendon sheath there was immediate relief. Welti, in 1896, reported a similar case, due to overexertion of the thumb, which was successfully treated by extirpating the entire tendon sheath fascia. In 1903 Marion, without knowledge of de Quervain’s report, cited several cases which he treated conservatively. Poulsen, in 1911, reported two cases and suggested that the lesion might be a periostitis due to traction by the tendon sheath fascia. In 1912 de Quervain reported eight additional cases which were cured by operation. He stated that the most frequent exciting cause was overexertion from household duties; occasionally there was a gouty or rheumatic history. Tuberculosis and syphilis were excluded in the entire group. During the same year Flörcken described two cases, diagnosed at first as tuberculosis of the radius, but in view of negative x-ray findings, he finally decided that he was dealing with de Quervain’s disease. Conservative treatment was unsuccessful in both cases. Michaelis attributed the cause to a thickening of the tendon sheath due to chronic inflammation of the ligament, producing a constriction of the tendons. The tendons showed no pathological changes. Burk, also in 1912, ascribed the cause to an habitual subluxation of the carpometacarpal joint. Nussbaum, in 1916, gave a résumé of forty cases previously reported. The histological findings were emphasized and will be referred to later. Keppler, in 1917, reported twenty-five cases seen within a period of eighteen months; seventeen were operated upon, and eleven of these, in which a follow-up examination was obtained, reported no recurrences of the complaint. He also described the histological findings in twelve patients. He concluded that the process was a chronic inflammation caused by protracted or repeated aseptic irritations. In 1919 Vischer added nine cases; and in 1920 Goeldel reported nine cases of styloiditis, stating that it was very easy to mistake epicondylitis of the styloid process of the radius for inflammation of the tendon sheath or stenosing tendovaginitis. In the same year Reschke reported ten cases. He found that in protracted cases the tendons were secondarily affected. He treated acute cases conservatively with many failures. In chronic cases division of the tendon-sheath compartment was the only effective procedure. Troell reported six cases in 1921, four of which he described, one with snapping fingers (doigt à ressort). One of his cases resulted from a tendovaginitis crepitans. He believed that stenosing tendovaginitis and cases of snapping finger had the same etiology, genesis, and pathological anatomy. Fischer, in 1923, discussed twelve cases of styloid epicondylitis, six of styloid neuralgia, and one of stenosing tendovaginitis. In the same year Hauck described cases of snapping finger without the presence of stenosing tendo-
stenosing tendovaginitis

vaginitis, some in which the two were combined, and also gave a description of true stenosing tendovaginitis. He concluded that there were no marked differences between the macroscopic and microscopic findings in the latter two groups, the genesis of both groups being traumatic. Eschle presented a résumé to 1924, reporting on one hundred and ten cases, and added nineteen of his own. His patients were all relieved by operation. In one, the stenosis followed a fracture of the radial styloid with callus formation. The following year Kroh published the results of his investigation of fourteen cases of snapping fingers and stenosing tendovaginitis of the flexor tendons of the fingers. Hanson reported an interesting case in 1926, in which he found an incompletely ruptured tendon, following a trauma. He concluded that the tendon sheath was not primarily affected in all cases. In 1927, Eichhoff added five cases to the literature, and suggested a mechanical causation as responsible for some of them, which will be discussed later under etiology. Finally, Winterstein, in 1927, reviewed all accessible cases previously reported, numbering one hundred and forty patients; and added fourteen of his own, four of which were operated upon with complete success. He stated that this condition most frequently affects women of advanced years, the ratio of women to men being approximately ten to one. The average age was fifty-five years, the youngest fifteen. There was no predilection for the right or left hand. Keppler reported two bilateral cases and Winterstein four. Schneider reported fifteen cases. The duration of the disease varied from two weeks to one year. The majority were comparatively early cases. Thirteen received conservative treatment. This consisted of the application of plaster casts to the wrist and thumb, the latter in a position of full extension and abduction. The duration of the treatment was from four to six weeks. Eight of these patients were cured; of the five unimproved cases, two were subsequently operated upon with successful results. The conservative treatment, as advocated by Schneider, resulted in cures in about sixty per cent. of the cases. This surpasses the results obtained by any previous observer. Eschle collected sixty-six cases which were treated surgically; sixty-five cases were cured, and one improved. We are reporting twenty-four cases, twenty in women, four in men. The ages ranged from fifteen to sixty-two years in women, and from twenty-three to fifty years in men. The average age in women was thirty-eight years, in men thirty-nine years.

ETIOLOGY

Stenosing tendovaginitis is encountered most frequently in the laboring classes, which leads to the assumption that it is of traumatic origin. An acute traumatic onset is rather infrequent, having occurred in but six of the author's series. The general impression prevails that the inciting factor must be attributed to a chronic trauma. Cases are reported to have developed after prolonged piano-playing, following the use of a typewriter or adding machine, as the result of excessive writing, washing and wringing
out clothes, chopping wood, carrying heavy objects, farm labor, cutting cloth with heavy scissors, etc. The writer's statistics on occupation are as follows:

FIG. 1
Muscles of the arm. Showing the arrangement of the tendons and their sheaths on the dorsal surface of the hand and wrist (From Spalteholz's Atlas of Human Anatomy).
**Females:** One piano player, one bookkeeper, one maid, one factory worker, one governess, one dancer, fourteen houseworkers.

**Males:** Two tailors, one cutter, one grocery clerk.

Some observers assume a gouty or rheumatic origin. Only three of the author's cases gave a positive rheumatic history. No cause whatever could be elicited in four cases. Syphilis and tuberculosis were uniformly absent.

Eschle suggests that the cause of the thickening of the tendon sheath over the styloid process of the radius is chiefly a mechanical one. It is produced by increased friction of the tendons of the two muscles over the long groove at the distal radial end. This friction may be increased quantitatively by exertion. One may assume that the tendon sheath becomes oedematous, which further causes increased friction, and that in this manner a vicious circle is formed, the ultimate result of which is a thickening of the tendon sheath. The friction may be increased qualitatively if the normal smooth osseous base is changed by a trauma.

Eichoff explains the cause of many cases as follows: "Work requiring a constantly repeating movement of the wrist, especially in ulnar abduction, with the thumb fixed on some object. With each movement in this position, the tendons of the extensor brevis and abductor longus muscles become taut over the styloid process of the radius and press upon the tendon sheath, which is unable to avoid the pressure because it lies close to the bone. As a second factor,—during the ulnar abstraction of the hand with a fixed thumb, stretching of the entire tendon sheath is produced. The extension of the tendons of the two muscles is strongest when the thumb is in opposition to the hand in middle posture. If the hand with the thumb is now abducted in ulnar direction, then both tendons, and with them the tendon sheath, must be overstretched. A simple experiment will verify this assumption. If one places the thumb within the hand and holds it tightly with the other fingers, and then bends the hand severely in ulnar abduction, an intense pain is experienced on the styloid process of the radius, exactly at the place where the tendon sheath takes its course. The pain disappears the moment the thumb is again extended, even if the ulnar abduction is maintained. In cases of forced abstraction of the hand without simultaneous involvement of the thumb, one does not succeed in evoking this pain. Thus repeated overstretching of the tendon sheath results in an injury to the gliding mechanism."

![Fig. 2](image)

Transverse section showing the compartments for the passage of tendons at the wrist (From Gray's Anatomy).
ANATOMY

Material for anatomical study of the structures occupying the first compartment on the dorsal surface of the distal end of the radius, was obtained from five recent autopsies. After incising the skin and superficial fascia and retracting the superficial branches of radial nerve and vein, the tendon sheath surrounding the abductor longus and extensor brevis pollicis tendons is exposed. It is about two and one-quarter inches in length. This sheath is strengthened by the addition of some transverse fibers about five-eighthes of an inch wide, which are dull, pearly gray in color (ligamentum carpi dorsale). On moving the thumb in flexion and extension, the tendons are felt to glide smoothly back and forth. The proximal end of the sheath is nicked, a fine probe is passed through the sheath and emerges at a nick in the distal end. There is no obstruction encountered. The anterior wall of the sheath is now entirely opened; it is about one-thirty-second of an inch in thickness, lined by synovial membrane. Within the sheath are the two tendons, shiny, pearly gray in color, occupying the common compartment on the outer side of the styloid process of the radius. The radius is grooved and covered by the posterior layer of the sheath. At the margin of the sheath the synovial membrane is invaginated and goes over into the tendon as epitenon. The tendon itself, therefore, is closely connected with the tendon sheath, but in such a manner that in one or another direction a certain capacity for movement is permitted (Mayer and Biesalski). The first compartment is separated from the second by a bony ridge, to which is attached a vertical prolongation of the dorsal carpal ligament.

![Fig. 3-A](image-url)  
Schematic drawing showing the dorsal carpal ligament, tendons, and sheaths on the dorsal surface of the hand and wrist.

![Fig. 3-B](image-url)  
Schematic drawing showing the ligament, tendon, and sheath viewed laterally.

![Fig. 3-C](image-url)  
Schematic drawing showing the structures occupying a normal compartment at the dorsal surface of the wrist: a. tendon, b. sheath, c. ligament.
Microscopic Anatomy

The inner surface of the tendon sheath is lined by a flattened layer of cells (hereinafter to be designated as "the synovial layer"). Immediately outside this synovial layer is a rather loose, cellular, connective tissue, containing fine thin-walled capillaries and some larger vessels with thin muscular coats (the loose connective-tissue layer). This layer gradually fuses with a very dense fibrous and hyaline tissue which corresponds to the annular ligament (the ligamentous layer). There is no separation between the two latter structures; they apparently fuse imperceptibly with each other. The firm fibrous-like tissue that constitutes the annular ligament is practically avascular, and in its more superficial aspect it is covered by a thin, loose, connective-tissue layer containing blood vessels (the subcutaneous layer). (Fig. 4.)

Pathology

Reports on the pathologic findings in operated cases reveal striking differences of opinion by various observers. All, however, are agreed on one point,—namely, that the tendon sheath is considerably thickened and that it constricts the underlying tendons, interfering with their normal gliding mechanism. De Quervain describes the synovial surface as being intact, the surrounding fibrous tissue somewhat thickened, without evidences of fresh inflammation, such as round-cell infiltration. The tendons show no gross pathologic changes. He further adds that the success of the operative treatment demonstrates the justification of ascribing the chief
Fig. 4
Photomicrograph of the normal human tendon sheath. Low power.

a. Synovial layer (nearest the tendon).
b. Loose connective-tissue layer.
c. Ligamentous layer.
d. Subcutaneous layer (nearest skin).
significance to the thickened tendon sheath fascia. On the strength of the assumption that the pains are caused by constriction of the tendon sheath fascia, he resolved to remove only the external wall of the sheath and concluded that even partial excision is sufficient to effect a recovery. Flörecken and Michaelis were of the same opinion. Welti found the annular ligament lacking its usual glistening appearance, severely vascularized and infiltrated. Marion describes this condition as a serous synovitis because there is an effusion of fluid in the sheath. Keppler made microscopic examinations in twelve cases and found an increase of the rigid fibrous connective tissue, containing numerous vessels, in the region of which a round-cell accumulation of lymphocytic character was found. Undoubtedly, therefore, new blood vessels are produced, from the region of which the new formation of the connective tissue takes its origin. There is also a rapid decrease in nuclei and hyalin transformation. On the strength of these findings, Keppler believes the process to be a chronic inflammation caused by protracted irritation of an aseptic nature. Reschke, in addition to the thickening of the sheath, observed profuse fibrin coagulum upon the longitudinally grooved tendons, which in this area had lost their gloss. Microscopic findings of the thickened tendon sheath showed small-cell infiltration between taut connective tissue. Troell believes that the pathologic process may occur in the tendon, and refers to two cases, one of fusiform swelling, consisting of chronic granulation tissue of the abductor pollicis tendon, and another case in which the tendon was surrounded by a loose tissue, rich in blood vessels, in the ligament compartment.

Nussbaum divided the findings into two groups: The first group shows a considerable increase of connective tissue in the tendon sheath wall, three to four times the normal thickness. The fibers are more condensed than in the normal. The synovial membrane is absent. In the second group, the vessels and nerves in the loose connective tissue of the outer layer are infiltrated with numerous round cells. The middle layer consists of interlacing bands of connective tissue and shows, likewise, a round-cell infiltration of vessels and nerves. Some sections show small, irregular, necrotic areas. The vessels are more numerous on the inner side of this middle layer. The lumen end of the tendon sheath is frequently formed of necrotic masses.

Vischer concludes that in cases of stenosing tendovaginitis the affection always begins with inflammation, which is followed by fibrous changes. Eichhoff states that macroscopically a thickening of the tendon sheath was always found. In general, the tendons themselves show no pathologic transformations. They may be compressed, however, by the stenosis in such a manner that they become separated into fibers.

Although de Quervain stated that this disease occurred only in the tendon sheath of the abductor longus and extensor brevis pollicis tendons, the present writer found similar lesions in other tendon sheaths. There was one instance of involvement of the extensor carpi ulnaris tendon, and one in which the flexor longus pollicis tendon was affected. In another patient
on operation, the extensor longus tendon sheath was stenosed in addition to the usual first compartment structures, and finally the sheath of the extensor longus pollicis tendon was found stenosed, and associated with this lesion there was a ganglion extending into the wrist joint. In the latter case, the sheath of the first compartment tendons was slit, but found perfectly normal. Other observers have also stressed this point. Nussbaum reported involvement of the sheath of the flexor longus pollicis tendon. Hauck described a number of cases with similar lesions in the flexor tendon sheath of the thumb. Vischer described one case in which the extensor carpi radialis longior tendon sheath was affected in addition to the first compartment sheath, and cited another instance of involvement of the sheath covering the flexor sublimus tendon of the fourth finger.

MACROSCOPIC FINDINGS IN AUTHOR'S CASES

In mild cases the changes may be very slight. The tendon sheath is about twice the normal thickness, and no inflammatory changes are present. The tendons are thinned out at the point of constriction, and are somewhat larger in circumference beyond this area. They do not glide freely on movements of the thumb. There is seldom evidence of effusion within the sheath. In severe cases, the sheath may be very greatly thickened, being three or four times thicker than average, densely fibrous, or even of cartilaginous consistency, and the sheath is brownish or reddish in color. The normal pearly luster is lost. Adhesions may exist between the tendons and sheath, and at times between the tendons themselves. The latter may be flattened and thinned out, at times frayed and covered with granulation tissue. Beyond the point of constriction the tendons often are bulbous. On several occasions the writer observed a division of the first compartment into two halves by a ridge of dense fibrous tissue running through its center, each tendon being supplied with a separate sheath. This bridge naturally diminishes the compartment space and serves as a further mechanical hindrance to the normal gliding function of the tendons. Another condition frequently encountered was a separation of either or both tendons into several strands.

MICROSCOPIC FINDINGS IN AUTHOR'S CASES

In mild cases the synovial membrane is thickened, except at the point of constriction, where it is thin or entirely absent. The loose connective-tissue layer is considerably thickened and vascularized; the ligamentous layer is slightly thickened but not vascularized. Only rarely is there a line of demarcation between the loose connective-tissue layer and the ligamentous layer. In severe cases the synovial layer is completely destroyed, the loose connective-tissue layer is compressed and thinned out, while the ligamentous layer is markedly thickened and undergoes hyaline and cartilaginous transformation. There is also marked thickening of walls of blood vessels, and cellular infiltration of the tissues, numerous
Photomicrograph showing the normal structures of the first compartment on the dorsal surface of the radius in a rabbit.

1. Bony cortex
2. Loose connective-tissue layer.
3. Ligamentous layer.
4. Synovial process of the radius.

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lymphocytes being present. Between these two types there are many gradations.

ANIMAL EXPERIMENTS

In order to determine whether the lesions of stenosing tendovaginitis could be reproduced experimentally, a study of the first compartment on the dorsal surface of the lower end of the radius in rabbits was undertaken. The anatomical structures, both in the gross and microscopically, were found to closely resemble those found in the human, with but one exception,—namely, that instead of two tendons there was one fairly large tendon occupying this region (Fig. 5). A series of rabbits were then subjected to the following experiments*.

a. Four rabbits were sprayed with ethyl chlorid over the skin covering the radial styloid process. A whole tube of ethyl chlorid was used in each instance. These animals were examined two, four, eight, and ten weeks later.

b. In three rabbits friction with a round wooden handle was applied over the paws for from one to three minutes. Operations were performed two, four, and ten weeks later.

c. Three rabbits were traumatized by means of a metal mallet. Ten, fifteen, and twenty blows were struck. Operations two, four, and six weeks later.

In experiments a, b, and c, care was taken to avoid breaking the skin in each instance. In the following experiments the tendon sheath was exposed by incision through the skin and superficial fascia.

d. In two rabbits, a pledget of cotton dipped in pure carbolic acid was swabbed over the outer surface of the tendon sheath, followed by alcohol. Operation two and four weeks later.

e. In two rabbits, pure carbolic was similarly employed without alcoholic neutralization. Operation two and four weeks later.

f. In one rabbit the tendon sheath and tendon were pinched in several places by an artery clamp. Operation four weeks later and subsequently a second operation six months later.

g. In one rabbit the tendon sheath was exposed, incised, and then sutured tightly over the tendon with silk suture. Operation eight weeks later.

The results were as follows:

In experiments a, b, and c, a lesion closely resembling the changes encountered in stenosing tendovaginitis of humans, resulted in each animal. The pathologic changes varied somewhat in degree only. The tendon sheaths were found thickened, vascularized, constricting the tendons so that the passage of a probe usually met with an obstruction. At times there were adhesions between the tendon and tendon sheath, but in no instance was there any gross injury observed in the tendons themselves. Microscopically, the changes closely simulated the findings in human specimens,—namely, a destruction of the synovial layer, compression of the loose connective-tissue layer, a marked thickening of the ligamentous layer with vascularization (Fig. 6).

In experiments d, e, f, and g, the lesions were more decided. The

*All animal studies were carried out with the animals under ether anaesthesia. Operations were performed under strict aseptic precautions.
Fig. 6
Photomicrograph showing the pathologic changes in the tendon sheath of a rabbit four weeks after spraying the skin with a tube of ethyl chloride. Low power. The ligamentous layer is markedly thickened, having a fibrillar appearance. The connective-tissue layers are practically obliterated.

(Compare with the normal structures as shown in Fig. 5.) Same magnification.
tendons in most of the rabbits were affected to a greater or lesser degree. In mild cases the tendons lost their pearly luster, were covered with granulation tissue, adhesions formed between the tendons and sheaths; in severe cases, in addition to the above, the tendons were often frayed, thinned out in places, and in several cases necrotic changes were produced. The tendon sheaths were greatly thickened, fibrotic, and at times hyalin transformation occurred, with evidences of inflammatory reaction.

From the above experiments, we concluded that stenosing tendovaginitis in rabbits can be produced by thermal, chemical and mechanical traumatization. When the skin remains intact, injury to the tendon sheath is possible, but to the tendon itself, improbable.

SYMPTOMATOLOGY

The onset of stenosing tendovaginitis is usually gradual, occasionally acute, following a trauma or some unusual exertion. The patients invariably complain of severe pain about the tip of the styloid process, radiating down the thumb and up the forearm, and aggravated by movements of the thumb and wrist. Abduction of the thumb and ulnar abduction of the wrist are the most painful movements. Of the rotation movements, supination is more painful than pronation. Difficulty is experienced in grasping objects such as a spoon, fork, knife, or glass. Mild cases may not interfere with work, but severe types are incapacitating. At times the pains are of a neuralgic character, causing sleeplessness. The pain as a rule is not relieved by immobilization, physiotherapy, or medication. Objectively, there may exist a swelling over the region of the tendon sheath, causing obliteration of the anatomic snuff-box. There is distinct tenderness on pressure over the tip of the styloid process and the area immediately adjacent to it. A circumscribed thickening of the tendon sheath may be palpated, and frequently a cartilaginous thickening is felt over the styloid process, situated under the skin, not adherent to the underlying bone, and moving with flexion and extension of the thumb. It sometimes reaches the size of a pea. No grating is felt on movement of the tendons. The pains are increased by passively extending or abducting the thumb, and on making a tight fist. On grasping the patient's thumb and quickly abducting the hand ulnarward, the pain over the styloid tip is excruciating. This is probably the most pathognomonic objective sign. Strong flexion of the wrist also produces severe pain. X-ray examinations are uniformly negative. There were no positive Wassermann tests in the writer's series.

DIFFERENTIAL DIAGNOSIS

When one is fully acquainted with the symptoms of this condition, errors in diagnosis are very unlikely. However, the following diseases may have to be ruled out in the diagnosis: tuberculous tendovaginitis, tuberculous osteitis, tendovaginitis crepitans, periostitis, neuritis, arthritis of either gouty, rheumatic, gonorrhoeal, or syphilitic origin.
Fig. 7-A
Photograph of left hand showing swelling over styloid process.

Fig. 7-B
Incision exposing tendon sheath. Probe inserted through a proximal and distal incision.

Fig. 7-C
Sheath opened, exposing the two tendons.

Fig. 7-D
Tendons retracted, exposing the posterior half of the sheath.

Fig. 7-E
Entire thickened sheath excised. Probe occupies the position of the tendons.
Tuberculous tendovaginitis is less often primary than secondary, occurring usually by extension from a bone or joint focus. It is characterized by a serous exudate, sometimes forming compound ganglia, occasionally rice bodies may be palpated and there is distinct crepitation imparted to the examining hand. The lesion is rarely circumscribed. Aspiration of the fluid and animal inoculation may be necessary in doubtful cases. Tuberculous osteitis is exceedingly rare, seldom forms a swelling of any special form, and, when it occurs in this region, the bone itself is tender to pressure and not the tendon sheath. Movements of the thumb are not particularly painful. Negative x-ray findings nullify this diagnosis. The author has seen but one case in which the x-ray examination revealed a periostitis of the radius. The absence of friction during movements of the thumb rules against tendovaginitis crepitans. Negative neurologic findings and absence of hyperaesthesia argue against neuritis of the radial nerve branches. The constancy and uniformity of the complaint and the failure of anti-rheumatic therapy speaks against rheumatism. Negative history, blood and x-ray findings aid in excluding gout, gonorrhoea, and syphilis.

TREATMENT

In the acute stage conservative treatment is indicated. Several authors have reported cures. The treatment consists of immobilization in a plaster cast, compression bandage or splint, baking, massage, and diathermy, counterirritants in the form of vesicants applied over the swelling, and potassium iodid internally. If relief is not obtained within a period of four weeks, operative treatment is indicated. Under local anaesthesia, a two-inch incision is made through skin and superficial fascia. The tip of the styloid is at the center of this cut. The small branch of the radial nerve and superficial vein are avoided. A small opening is made into the proximal sheath and a fine probe is inserted in a downward direction; this usually meets with an obstruction. A small nick is made in the distal end of the sheath and a probe inserted upwards. This likewise meets with an obstruction; between the two probe tips lies the stenosed tendon sheath. Some observers merely slit this sheath, others remove a longitudinal strip, and some advise the complete removal of the entire circumference of the tendon sheath. Under any of these procedures the tendons are freed, and the patient usually experiences immediate relief. The superficial tissues are then sutured with fine chromic catgut, the skin with silk, and dressings applied. In about ten days normal function is permitted (Fig. 7-A—7-E).

PROGNOSIS

A review of the literature on end results following operative intervention is impressive. No failures have been recorded; nor is there any mention of recurrences in patients operated on. The writer has recently observed two cases operated upon ten and eleven months previously, still
complaining of pain on pressure over the styloid process. In both instances the tendon sheath on operation was found greatly thickened, inflamed, and cartilaginous in consistency. The technique employed in these cases was the removal of a thin strip of tendon sheath. In view of subsequent experiences the writer feels that removal of the entire tendon sheath would probably have resulted in a cure in both patients.

CASE REPORTS

CASE 1. History No. 13480, April 27, 1927, M. J., female, forty-nine years old houseworker.

Previous history: Had traumatic arthritis of knee two years ago.

Onset: Fell on left hand three weeks ago.

Symptoms: Pain over left styloid process, transmitted to thumb. Aggravated by abducting thumb and by ulnar abduction of hand. Unable to grasp objects. Insomnia. X-ray negative; Wassermann and gonorrheal complement fixation negative.


Microscopic examination: (S-1931) Some of the synovial layer destroyed in places; marked synovitis elsewhere. The loose connective-tissue layer shows marked vascularization. The ligamentous layer, thickened, consists mainly of fibrous tissue; no vascularization (Fig. 8).


CASE 2. History No. 16326, D. P., fifteen years old, piano player.

Previous history: Negative for rheumatism, gout, lues, tuberculosis. No history of trauma. Cause unknown.

Present history: June 27, 1927, severe pain over left styloid process, worse when practicing piano lessons, especially on attempting to strike octaves. Began insidiously. Treated conservatively at various clinics during past five months, without relief.

Examination: Tenderness over tip of styloid process. Swelling over tendon sheath and obliteration of anatomic snuff-box. Abduction of thumb, flexion of wrist, and ulnar abduction very painful. X-ray negative.

Operation: February 23, 1928, under local anaesthesia, one per cent. novocain.

Findings: Probe met with obstruction within the tendon sheath, the latter about three times normal thickness; cut like cartilage. Tendons do not glide freely. As soon as the sheath was incised, the patient could move thumb without pain. At the point of constriction, the tendons were very greatly compressed, flattened, and frayed, and of a dull grayish color; above the constriction the tendons were bulbous, reddish in color, and covered with granulation tissue. A small independent slit of the extensor brevis tendon occupied a separate compartment which was also stenosed. The constriction was incised.

Microscopic examination (S-2900): The synovial membrane is completely destroyed, the loose, connective-tissue layer is thinned out, the ligamentous layer on its outer surface consists of fibrous tissue which is loose and fatty, and contains numerous vessels, the arteries showing thickened walls. Towards the tendon surface, the tissue becomes more densely fibrous and less cellular, and finally consists of cartilaginous tissue, containing numerous cartilage-like cells, enclosed in lacunae. The innermost cartilage-like area contains no vessels. It extends in places to the very surface, directly covering the tendons.
Case 1. Photomicrograph of stenosing tendovaginitis. Low power.

1. Serosal layer destroyed in places.

b. Loose connective-tissue layer shows marked vascularization.

c. Ligament layer thickened, consists mainly of fibrous tissue, not vascularized.

Compare with normal structures in Fig. 4. (Same magnification.)

Case 3. History No. 11814, L. W., female, colored, twenty-four years old, maid.

Previous history: Cervical glands removed on one side during childhood. Influenza three years ago.

Present attack: Began two months ago; onset insidious; no injury. Experienced pain in right thumb and wrist when attempting to grasp objects. Symptoms progressively worse.


Operation: September 30, 1926, under local anaesthesia. The sheaths of the abductor longus, extensor brevis, and extensor longus tendons were found thickened, constricting the underlying tendons. Both sheaths were split.

Microscopic examination (S–1364): Synovial membrane missing. There was no evidence of the presence of the loose connective-tissue layer. The specimens consisted entirely of the ligamentous layer, which was markedly thickened, with hyaline and cartilaginous transformation. The blood vessels were thickened; there was cellular infiltration of the tissues with numerous lymphocytes.

Subsequent history: Two weeks later patient was discharged, relieved of all symptoms. Motion in thumb and wrist painless. Able to resume work. Last seen in March 1928, at which time there had been no recurrence.

Comment: Although the lesion was only of two months’ duration, this was one of the most severe cases encountered in the series. In addition, it was the first case in which a tendon sheath was affected outside the first compartment. Pathologically, it was one of the few cases demonstrating an extensive cellular infiltration of the affected tissues.

Case 4. History No. 12629, November 12, 1926, E. N., female, housewife, aged forty-three years.

Previous history: Eight years ago had an appendectomy.

Present history: Five years ago twisted right wrist; since then has complained of pains on the dorsum of the right wrist, ulnar side, numbness and tingling of the fingers of the right hand. The pain is located over the styloid process of the ulna and transmitted down the little finger. Attempts at flexing the little finger produce pain. Grasp of hand is good, but patient cannot lift heavy objects. Is unable to work; even sweeping floors is too painful. Recently suffers from sleeplessness owing to severe pains.

Examination: There is a soft-tissue swelling over the ulnar styloid. Pressure over this area is distinctly painful. Pain increased on flexing little finger and radially abducting the wrist. X-ray negative.

Treatment: Diathermy and immobilization ordered. After two months condition was aggravated.

Operation: January 13, 1927, under local anaesthesia.

Findings: Tendon sheath covering extensor carpi ulnaris, occupying the sixth compartment, considerably thickened. There was extensive granulation tissue formed between the sheath and tendon, and adherent to both structures. This had to be dissected away with a scalpel. The tendon in the constricted area was frayed out and dull looking. The groove in the bone was also covered with granulation tissue.

Microscopic examination (S–1633): In one section the synovial membrane is absent; in another it is thickened, markedly vascularized and covered with fibrin; the loose connective-tissue layer is enlarged and contains numerous round cells, eosinophils, and blood vessels. The ligamentous layer is thickened and very much vascularized. There
is considerable new vessel formation on its outer surface. (This is the most actively
reactive specimen in the series.) (Fig. 9.)

Subsequent history: Pains relieved immediately following operation. Discharged
from clinic two weeks later; movements of little finger and wrist free and painless. Last
seen in March 1928, at which time there had been no recurrence of symptoms. She
uses the hand freely, and has been working continually since discharge.

Comments: Contrary to the belief of de Quervain that stenosing tendovaginititis
occurs only in the first compartment, this case is positive proof that the lesion may
occur elsewhere. The clinical symptoms, operative findings, and microscopic examination
are definitely corroborative.

Case 5. History No. 16133, P. J., female, aged thirty-four, houseworker.

Previous history: Diphtheria during childhood. Operated on several years ago for
an abdominal tumor.

Present history: Onset in July 1927, with pain over dorsum of left wrist. Following
treatment for neuritis, pain grew worse. Swelling appeared on dorsum, pain radiating
to finger tips and up the forearm, worse on moving thumb. Hand and forearm tire
easily.

Examination: There is a ganglion-like swelling on the dorsum of the wrist, proximal
to the joint, more pronounced on hyperflexion and tender to pressure. There is also
tenderness on pressure along the extensor longus pollicis tendon. Movement of thumb
aggravates the pain. Urine, blood, Wassermann, and x-ray negative.


Findings: Markedly thickened tendon sheath covering the extensor longus pollicis
tendon, at least four times the normal thickness, cartilaginous in consistency. A
ganglion the size of a grape extended into the wrist joint between the lower end of the
radius and scaphoid. The sheath covering the first compartment tendons was opened
and found normal.

Microscopic examination (8–2827): The synovial membrane is missing at the constricted
portion. The loose connective-tissue layer is thinned and shows some slight
cartilaginous metaplasia; the ligamentous layer shows dense fibrous tissue, greatly
thickened.

Subsequent history: Pain relieved on the day following operation. February 3, 1928,
leaves hospital. February 15, 1928, resumed work. Last seen March 16, 1928. No
recurrence; patient entirely relieved.

Comment: This is another instance of tendovaginitis outside the first compartment.
Another point of importance is the fact that marked thickening of the annular ligament
may be responsible for ganglion formation, and unless this constriction is relieved by
incision, recurrences of the ganglion are likely.

Case 6. History No. 14681, A. B., female, aged thirty, housewife. No history of
rheumatism, gout, lues, or tuberculosis.

Previous history: Onset six months ago. No history of trauma; cause unknown.

Pain over styloid process of left radius, very annoying. Movements of the thumb, wrist,
and forearm painful. No difficulty in grasping objects.

Examination: No redness or swelling. Tenderness over the tip of the radial styloid;
flexion, extension, adduction and abduction of the thumb painful. X-ray negative;
Wassermann negative.

Operation: September 1, 1927, under local anaesthesia. On opening the first com-
partment, it was found divided in two parts by a dense fibrocartilaginous ridge. Each
tendon had a separate sheath. That covering the extensor brevis pollicis was densely
fibrous and thickened. As soon as the sheath was incised the tendon showed free gliding
function. The tendon itself was of normal appearance. The sheath covering the
abductor pollicis tendon appeared normal. It was opened, however, and the cartilagi-
nous ridge was excised. Both tendons then functioned normally. Microscopic find-
ings were those of a mild stenosing tendovaginitis.
Fig. 9

Case 4. Photomicrograph of stenosing tendovaginitis showing deposit of fibrin on the synovial surface of the tendon sheath. Low power.

a. Fibrin covering the synovial membrane.
b. Synovial layer thickened and vascularized.
c. The loose connective-tissue layer is thickened and contains numerous round cells, eosinophils and blood vessels.
d. The ligamentous layer is thickened and very vascular.
Subsequent history: Discharged three weeks later; symptoms relieved. March 3, 1928, condition excellent, motions of thumb and wrist free and painless. Patient able to perform all household duties.

Case 7. History No. 13873, L. K., female, forty-five years old, housewife.

Previous history: Negative.

Present history: Onset two months ago. No known cause. Right wrist affected. Typical symptoms.

Operation: June 8, 1927. Extensor brevis pollicis and abductor longus pollicis each occupied separate compartments, a dense fascial septum intervening. The latter was excised, and constriction removed. Microscopic findings were those of a typical mild case.

Subsequent history: Recovery uneventful. On March 5, 1928, a letter was received, stating that patient was entirely relieved of painful symptoms.

Case 8. History No. 13626, C. St., female, colored, aged thirty-three, factory worker.

Previous history: Had facial neuralgia several years ago.

Present history: Onset four months ago. Struck right hand against leg of table. Pain over styloid, extending down the thumb and up to the shoulder. Movements of thumb and wrist painful. Poor grip. Recently dropped an iron while pressing clothes. Cannot sleep at night unless hand is extended over the head.

Examination: Marked swelling over sheath of first compartment. Tenderness on pressure over the styloid process and about one inch below. Limitation of abduction of thumb and ulnar abduction of wrist. X-ray negative; Wassermann negative.

Operation: May 12, 1927, under local anaesthesia. Both tendons occupied separate compartments. Dense fibrocartilaginous ridge divided both tendon sheaths. The sheaths over both tendons were thick, congested, and cut like cartilage. Strip of each tendon sheath removed. Cartilaginous ridge excised.

Microscopic examination (S-1975): Synovial membrane destroyed. The loose connective-tissue layer thickened and vascularized. The outer or ligamentous layer thickened but not much vascularized.

Subsequent history: March 4, 1928. Patient satisfied with operative result. Has no night pains. Movements of thumb and wrist free. Cannot do heavy work. Pressure over sheath painful. In this case complete removal of the sheath, instead of a narrow strip, would probably have resulted more favorably. Patient refuses further intervention.

"Comments: The last three cases demonstrate an anatomic anomaly which is occasionally encountered,—namely, a division of one compartment into two halves by a dense fibrocartilaginous ridge. In one of the cases only a single tendon was constricted; in the remaining two, both tendons were involved.

Case 9. History No. 13536, May 1, 1927, S. L., male, aged fifty years, tailor.

Previous history: Negative.

Present history: Onset one year ago; window fell on right wrist. Suffered from pain on radial side of wrist, transmitted down the thumb and index finger. Could not hold objects.

Examination: There is slight redness over right radial styloid, moderate swelling, obliteration of the anatomic snuff-box. Tenderness on pressure over tip of styloid and first interphalangeal joint of thumb. Limitation of abduction and extension of thumb, flexion and ulnar abduction of wrist. X-ray negative. Treated conservatively for three months, without relief.

Operation: May 4, 1927. Anterior wall of tendon sheath was found greatly thickened and of cartilaginous consistency, contracting lumen for a distance of one-half inch.
Case 9. Photomicrograph of stenosing tendovaginitis. Low power.

a. The synovial layer is barely visible.
b. The loose connective-tissue layer is thickened and vascularized.
c. The ligamentous layer is greatly thickened and vascularized.
d. There is a distinct line of demarcation between the loose connective-tissue and ligamentous layers, which is very infrequently encountered.
The tendons were constricted, flattened, and fibrillated. As soon as the sheath was opened, movements of the thumb were free and painless.

Microscopic examination (S-1939): The synovial layer is barely visible. The loose connective-tissue layer is thickened and vascularized, the ligamentous layer is more than twice the normal thickness and is also very much vascularized. There is a distinct line of demarcation between the loose connective-tissue layer and ligamentous layer (Fig. 10).

Subsequent history: Wound healed in ten days. In response to a follow-up letter, patient returned to the clinic on March 8, 1928. He feels better, is able to do ordinary work, and can hold objects securely, but cannot raise heavy objects. There is a tenderness on pressure over the styloid process and pain on ulnar abduction. All other movements are painless.

Comments: This is another instance, the second in the series, in which pain recurred following operative intervention, due probably to the fact that the entire sheath was not removed at operation. The fibrillated condition of the tendons was seen in several other cases where the sheath was greatly thickened, and produced severe constriction of the enclosed tendons. This is also the only case in which there was a distinct line of demarcation between the loose connective-tissue layer and the ligamentous layers.


Previous history: Had scarlet fever at twenty-two; denies venereal disease.

Present history: Sixteen months ago patient noticed a snapping sound on moving the right thumb. As time elapsed, the snapping increased and the thumb joints became somewhat stiffened.

Examination: Tenderness on pressure over the flexor longus pollicis tendon at the metacarpophalangeal joint. There was grating in this joint on flexion and extension. There are only fifteen degrees of flexion in the distal phalanx. Extension painful.

Operation: October 7, 1926, under local anaesthesia. The flexor longus pollicis tendon exposed at the metacarpophalangeal joint of the right thumb. A fusiform swelling of the tendon was observed, about one centimeter long. No adhesions between tendon and sheath, but marked constriction of the tendon distal to the swelling, due to thickened sheath. The latter was slit open for a distance of two inches.

Microscopic examination (S-1387): The synovial membrane and loose connective-tissue layer are entirely destroyed. The whole specimen consists of fibrous tissue, markedly thickened, with considerable deposition of calcific material and a metaplasia of the tissue into cartilage (Fig. 11).

Subsequent history: Stitches removed October 18, 1926; wound healed. Movements of thumb free and painless. Last examined March 8, 1928, at which time there had been no recurrences; patient had been attending to her work without interruption.

Comment: This case is included under the heading of stenosing tendovaginitis. The lesion and symptoms were entirely due to a thickened sheath, interfering with tendon function. The snapping was due to the fusiform swelling being forced under the constriction during extension of the thumb. Removal of constriction resulted in relief of all symptoms.


Present history: Pains in right wrist, near styloid process of radius, for past eleven months.

Examination: Tenderness over sheath occupying the first compartment. Pain aggravated by abduction of thumb, flexion of wrist, and ulnar abduction.

Treatment: Conservative, consisting of physiotherapy and later immobilization in a cast. No relief.

Operation: May 5, 1926. Tendon sheath found thickened, constricting the enclosed tendons. Narrow strip of tendon sheath excised.

Subsequent history: Wound healed by primary union. Discharged two weeks later. Symptoms entirely relieved. Motions of thumb and wrist free. In answer to questionnaire March, 1928, states that there has been no recurrence.
Case 10. Photomicrograph of stenosing tendovaginitis. High power. Showing markedly thickened fibrous tissue, considerable deposition of calcific material, and a metaplasia of the tissue into cartilage. The synovial and loose connective-tissue layers have been destroyed; the specimen consists entirely of ligamentous layer.
CASE 12. History No. 13742, I. T., male, aged forty-six, tailor.

Present history: Suffering from pains in right wrist for two months, aggravated during the past two weeks.

Examination: Tenderness over right radial styloid, pain on abduction and extension of thumb and on ulnar deviation of wrist.


Subsequent history: There was a slight stitch abscess, which cleared up after stitches were removed.

End result: Excellent function; relief of symptoms.

CASE 13. History No. 13335, L. R., female, forty-five years old, housewife.

Chief complaint: Pain in left wrist and forearm when thumb is extended. Duration eight weeks. No history of trauma.

Examination: Tenderness over left styloid process, aggravated by abduction of the thumb and ulnar abduction of wrist.


Subsequent history: March 5, 1928. Uses hand freely, no pain nor restriction of motion in thumb or wrist. Attends to all household duties.


Chief complaint: Pain in left wrist and thumb. Duration five months. No history of trauma.

Examination: Tenderness over left styloid of radius, aggravated by extension of thumb and ulnar abduction.


Subsequent history: Discharged two weeks later. Movements of thumb and wrist restored.

End result: Excellent.

CASE 15. History No. 11487, E. B., female, thirty-six years old, housewife.

Chief complaint: Pain over bunions of both big toes. Pain in right wrist on radial side.

Examination: Double hallux valgus. Tenderness over right radial styloid. Restriction of abduction of thumb and ulnar abduction of wrist.


Subsequent history: Discharged August 13, 1926. Wound healed by first intention.

End result: Excellent.


Chief complaint: Pains over lower end of left radius past six weeks, aggravated by flexing thumb. Cannot grasp objects. No history of injury.

Examination: Tenderness over left styloid. Restriction of abduction of thumb and ulnar abduction of wrist.

Operation: April 14, 1927. Tendon sheath found thickened and cartilaginous in consistency. The tendons do not move freely on voluntary flexion and extension of thumb. Sheath excised. Tendons glide freely. The tendons beneath the constriction are flattened out and of dull appearance. Above and below constriction the tendons are covered by granulation tissue.

Microscopic report (S-1893): Synovial membrane thickened, loose connective-tissue layer thickened and vascularized.

Subsequent history: Wound healed by primary union. Discharged in two weeks. Symptoms relieved.

End result: Excellent.
CASE 17. History No. 13537, B. K., female, fifty-eight years old, houseworker.

Present history: Increasing pains over the radial side of the right wrist for past six months. Disability marked. Grasping movements impossible. Motions of thumb painful and limited. Treated conservatively during this period, with no relief. No history of injury. No cause known.

Examination: Right radial styloid very tender to pressure. Definite circumscribed swelling over lateral aspect of the styloid process. Limitation of extension and abduction of thumb. Restricted ulnar abduction of wrist.

Operation: May 4, 1927. On opening sheath, two drops of cloudy fluid exuded and swelling decreased. Tendon sheath markedly thickened, dull gray in color, and adherent to the abductor tendon. Adhesions also found between the two tendons. Constriction freed. Active abduction of thumb free and painless.

Subsequent history: Wound healed primarily. Patient returned to work two weeks later.

End result: Excellent. Last seen March 5, 1928. Doing all her housework, with no pains and no restriction of motion.


Previous history: No history of rheumatism, gout, lues, or tuberculosis.

Present history: Fell on January 25, 1927, injuring left wrist. Pains transmitted to thumb. Cannot grasp objects. Movements of the thumb or wrist in any direction cause aggravation of the pain. Wrist was in plaster for two months with relief.

Examination: Tenderness over the tip of the left radial styloid. Limitation of extension, flexion and abduction of thumb. Flexion of wrist and ulnar abduction also painful.

Operation: August 17, 1927. Tendon sheath found thickened. Incised.


Chief complaint: Pain in left thumb for many months. No cause known. No appreciable improvement following conservative treatment.

Examination: Tenderness over short extensor tendon of left thumb. Extension of thumb painful. Ulnar abduction limited.


Microscopic report (S-2185): Synovial layer absent. Loose connective-tissue layer has disappeared excepting at the periphery of the specimen. The ligamentous layer is extremely thickened, with degeneration of some of the fibrous tissue; calcareous deposition in the outer portion of this layer. There are many round cells surrounding the blood vessels (Fig. 12).

Subsequent history: Wound healed primarily. Discharged twelve days later. Symptoms relieved. February 14, 1928, replied to questionnaire, stating that all her symptoms were relieved.

CASE 20. History No. 15830, T. K., male, thirty-five years old, cutter.

Previous history: Sustained an injury to the right wrist in May 1927. Wrist and back of hand were painful and swollen.

Present history: In July 1927, experienced pains over the right styloid process. When using scissors pains were increased. Unable to grasp objects.

Examination: Tenderness over tip of styloid, extending to thumb. Ulnar abduction painful. Extreme weakness of grip.

Operation: January 5, 1928. Tendon sheath found greatly thickened, interfering with gliding function of both tendons in the first compartment. The sheath was three-sixteenths of an inch thick, and cartilaginous. The tendons were flattened and constricted.
Case 19. Photomicrograph of stenosing tendovaginitis. Low power. Almost
the entire specimen is replaced by the ligamentous layer, which is extremely
thickened, with degeneration of some of the fibrous tissue, and calcareous deposi-
tion in the outer portion of this layer. There are many round cells surrounding
the blood vessels. The synovial and loose connective-tissue layers are almost
entirely destroyed.

a. Synovial layer.
b. Loose connective-tissue layer.
c. Ligamentous layer.

(Compare with the normal, Fig. 4. Same magnification.)
Microscopic examination (S-2716): The synovial membrane is thickened. The loose connective-tissue layer is also increased in width; the ligamentous layer shows fibrotic changes with hyalin degeneration at its innermost portion. It is considerably vascularized.

Subsequent history: The patient returned to work three weeks later. Last seen February 27, 1928. Function normal. No limitation of motion in any direction. There is slight numbness over back of thumb and thenar eminence, probably due to cutting some superficial branch of the radial nerve.

Case 21. History No. 13551, E. S., female, aged forty-nine, houseworker.
Chief complaint: Pain in the right thumb for the past three months, aggravated by extension and abduction. Flexion and ulnar abduction of the wrist also painful. Treated conservatively without relief.
End result: Completely cured. Last examined in February 1928.

Case 22. History No. 15349, V. H. R., female, twenty-seven years old, bookkeeper.
Previous history: No recent illness; no history of trauma.
Present history: Pains in left wrist, radiating down the thumb. Duration six months. Conservative treatment failed to give relief.
Examination: Tenderness beneath the radial styloid tip, aggravated by motions of thumb and ulnar abduction of wrist.
Operation: November 10, 1927. Sheath found thickened and tendons of the first compartment constricted. Strip of sheath excised.
Microscopic examination (S-2518): Disappearance of synovial layer, very little left of the loose connective-tissue layer. Cartilaginous transformation with calcific metaplasia of the ligamentous layer.
End result: Pain relieved; function returned to normal.

Case 23. History No. 12698, J. C., female, sixty-two years old, houseworker.
Previous history: Sustained an injury to the left wrist, following a fall seven months ago. The wrist became swollen and patient was unable to attend to her household duties.
Present history: For the past six months patient has had severe pains over the left styloid process. Movements of the thumb are painful. Cannot hold objects.
Examination: Marked tenderness on pressure over tip of left radial styloid. Abduction of thumb painful. Ulnar abduction increases pain; flexion of wrist aggravates the condition. There is swelling over the first compartment, with obliteration of the anatomic snuff-box. X-rays negative.
Operation: January 27, 1927. Tendon sheath greatly thickened and cartilaginous. The tendons are tightly constricted, with a fullness distal to the point of constriction. As soon as the constriction was relieved by incision, patient moved thumb freely and painlessly.
Microscopic examination (S-1667): The synovial membrane is visible at the periphery of the section, but destroyed elsewhere. The loose connective-tissue layer is made up of endothelial cells a few layers thick. Some of the cells are spindle-shaped, others polyhedral. The cytoplasm is rather granular. The blood vessels show thickening of the coats in places. A few round cells are seen. The ligamentous layer is extremely thickened, consisting of hyalinized connective tissue, containing in places a bluish-staining, calcific intracellular material. There are no evidences of recent inflammation.
End result: Complete relief of pain and return of function. Last examined in February 1928.
Fig. 13

Case 24. Photomicrograph of an unusual case of stenosing tendovaginitis, showing the presence of a large cystic mass. This has probably arisen as the result of degeneration of the cellular and collagenous tissues, similar in origin to that of a ganglion. Low power.

Previous history: Negave; no history of trauma or exertion.

Present history: Began five months ago with pains of a boring character in the left wrist. Not transmitted to thumb or forearm. Is able to grasp objects; movements of fingers and wrist free.

Examination: There is a swelling at the tip of the radial styloid, about the size of a large pea, movable on the underlying bone and also movable on flexion and extension of the thumb. Ulnar abduction painful; all other movements of thumb and wrist free, excepting extreme abduction of the thumb. There is obliteration of the anatomic snuff-box. X-ray negative.

Operation: May 10, 1928. The swelling was due to an extremely thickened tendon sheath of almost cartilaginous consistency; it was easily six times the normal thickness. The tendons were not constricted. The entire sheath was removed.

Microscopic examination (S-3181): The synovial layer is destroyed. There is very little remaining of the loose connective-tissue layer. The annular ligament is markedly thickened, the deeper portion taking on the character of fibrocartilage. The more superficial portion is vascular. There is a large cystic area occupying about a low power field. One of the several cysts in the thickened annular ligament is shown in Figure 13. It is either a lymph cyst or the result of degeneration of the collagenous material.

End result: Patient discharged two weeks later, relieved of pain. Function normal. Last examined in July 1928.

SUMMARY

Stenosing tendovaginitis is a disease frequently encountered. Twenty-four cases were operated upon in a single institution within a period of two years. The laboring classes are most frequently affected. Chronic trauma and overexertion are the most common causes. The disease can be produced experimentally. The common tendon sheath of the abductor longus and extensor brevis pollicis muscles, occupying the first compartment on the dorsum of the radius, is most frequently involved, but any of the tendon sheaths on the flexor or extensor surfaces of the wrist may be affected. Only one bilateral case was encountered, but because the patient refused to submit to operation, the diagnosis could not be definitely confirmed. The pathologic changes are usually limited to a fibrous thickening of the tendon sheath, without evidences of acute inflammatory reaction. There may finally occur calcareous deposits in the sheath. In rare instances, however, the lesion may occur in the tendon itself, and often there are distinct evidences of inflammatory reactions in the peritendinous structures. The pain over the styloid process of the radius may be excruciating, causing disability and interfering with the pursuit of a livelihood. The disease is progressive; not amenable, except in rare instances, to conservative treatment after four weeks' duration; but responds readily to operative intervention, which consists of splitting the stenosed tendon sheath, or in severe cases, the entire removal of the tendon sheath.

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