Dupuytren's Contracture

With Special Reference to Pathology*

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Dupuytren's contracture, first described by Plater in 1614, was reported in 1823 by Astley Cooper. In 1832 Dupuytren described the dissection of a hand with contracture of the palmar aponeurosis and recommended division of the contracted bands. For a review of the anatomy of the palmar fascia, the reader is referred to the works of Kanavel, Koch, and Mason, Harper, Skoog, and Kaplan.

This paper is based upon our experience with ninety-nine patients who had Dupuytren's contracture. Bunnell summarized the reported incidence of Dupuytren's contracture in the general population, estimating that the disease occurs in, roughly, 1 to 2 per cent of the population. We found that the contracture is encountered more frequently in the older age groups. Among our patients there was one between the ages of ten and nineteen years (a twelve-year-old girl); three, between the ages of twenty and twenty-nine; eight, between the ages of thirty and thirty-nine; eighteen, between the ages of forty and forty-nine; forty, between the ages of fifty and fifty-nine; twenty-two, between the ages of sixty and sixty-nine; and seven, between the ages of seventy and seventy-nine. This age distribution agrees well with the statistics published by Skoog, Conway, Boyes, Graubard, James and Tubiana, and many others. Two in this series, one man and one woman, were Negro; the remainder were Caucasian.

As indicated in Table I, the contracture is more common in the right hand than in the left hand, and is more commonly bilateral than unilateral. The contracture may also occur in the plantar aponeurosis [44]; only five of our patients were so affected. The ulnar side of the hand is most often involved in Dupuytren's contracture. Table I shows the agreement between the present series and the collected series of Skoog. He collected 2,278 cases from the literature. One thousand, two hundred and fifty-one (55 per cent) had bilateral contracture; 663 (29 per cent) had the right hand only involved; and 364 (16 per cent) had only the left hand involved. In this same group the thumb was involved seventy-three times; the index finger, 123 times; the middle finger, 536 times; the ring finger, 1,451 times; and the little finger, 1,217 times.

In our series there were seventy-nine men and twenty women, a ratio of approximately four to one. In most reported series the ratio has been about eight to one. We have no explanation for the higher proportion of women in our group of patients.

The earliest recognizable stage of Dupuytren's contracture is a nodule in the palm, usually located in line with the ring finger, and most often at the distal palmar crease. The nodule is painless and does not limit the function of the hand. The skin is attached intimately to the nodule. As the disease progresses more nodules appear which gradually become organized into one or more contracted longitudinal bands. These bands gradually draw the metacarpophalangeal joints and proximal interphalangeal joints into flexion. The distal interphalangeal joints are not involved. The rate at which the contracture progresses is quite variable; in some patients a severe contracture develops in only a few months, while in others, the same degree of disability may not be present for years. The progress of the disease may be arrested spontaneously at any stage. We do not know any way to predict the course of the disease in an individual patient.

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TABLE I

INCIDENCE OF DUPUYTREN'S CONTRACTURE

Location	Present Series (No.)	Present Series (Per cent)	Skoog's Reported Series (No.)	Skoog's Reported Series (Per cent)
Right hand	29	29	663	29
Left hand	24	24	364	16
Both hands	46	46	1,251	55
Little finger	72	73	1,217	53
Ring finger	75	76	1,451	64
Middle finger	28	28	536	24
Index finger	10	10	123	5
Thumb	15	15	73	3
Palmar nodules only	32	32		

REVIEW OF THE LITERATURE

Etiology

The etiology of Dupuytren's contracture is unknown. Dupuytren thought it due to repeated trauma; recently authors have felt that trauma is not an important factor. Moorhead has stated this view unequivocally. In our series of patients there were fifty-four who had never done manual labor of any kind. Eight patients had occupations which required occasional moderately heavy use of their hands. The remaining thirty-seven were laborers. On the basis of these figures we agree with the series reported by Kanavel, Koch, and Mason, in which they found that Dupuytren's contracture was more apt to be encountered in patients who did not perform manual labor.

Other diseases which have been related etiologically to Dupuytren's contracture include neuropathy, both peripheral and central, disorders of the sympathetic nervous system, neurosyphilis, gout, rheumatism, disorders of the endocrine system, such as diabetes, deficiencies of the thyroid and pituitary glands, tuberculosis, various chronic intoxications, local infections, epilepsy, and coronary-artery disease. None of our patients had any of these diseases except that one had diabetes and another, epilepsy.

The majority of authors agree that heredity is involved in some cases of Dupuytren's contracture. Schröder reported that ten of his thirty patients had relatives with the contracture. Skoog reported a positive hereditary history in twenty-two of his fifty cases. In our series eight patients had relatives with the disease. Many of our patients were Americans of the first or second generation who had no knowledge of their relatives overseas.

Gross Pathology

The pathological changes observed in Dupuytren's contracture have been described by several authors. Dupuytren himself described the macroscopic changes in the palmar aponeurosis. He described shortening and retraction of the palmar fascia and noted bands of contracted fascia passing into the affected fingers. Today there is little argument that the disease does involve the palmar fascia, although some consider that the palmar fascia is secondarily involved in an inflammatory process which arises in the interstitial tissues of the hand. Kanavel, Koch, and Mason concisely described the relationship between the palmar fascia and the digital fascia. They observed that the pretendinous bands of the palmar fascia pass into the superficial digital fascia. The vertical septa which lie between the tendons and neurovascular bundles of the palm pass into the deep digital fascia. These fascial fibers passing from the palm into the fingers ultimately attach to the sides of the proximal and middle phalanges. Kaplan in 1938 observed flexion of the proximal and at times of the middle phalanges when the pretendinous bands of the palmar aponeurosis

were pulled. Flexion of the phalanges did not occur in those hands in which no pretendinous bands passing into the fingers could be identified. He concluded that the flexion contracture of the phalanges in Dupuytren's contracture depended upon the contracture of the phalangeal insertion of the pretendinous bands. Richer in 1877 described the hard thickened short fascia, which he felt resulted from an increase in the size and number of elastic and collagen fibers. He did not note any inflammation.

Our gross observations are as follows. The hard nodules and bandlike areas lie within the palmar aponeurosis. In many areas the skin is intimately attached to the thickened palmar fascia. At times the skin is so firmly bound to the fascia that the two cannot be separated except by creating an artificial dissection plane with a scalpel. Occasionally such skin is of necessity excised. These areas of firm attachment between the skin and the fascia are most often noticed at the distal flexion crease of the palm, or in the flexion creases of the fingers, where adipose tissue is normally scanty.

The nodules and bands vary in appearance. These variations appear to coincide with the stage of maturity of the contracture in that particular area. The younger tissue is gray white and softer than the more mature tissue. The gray-white areas, often in nodular form, do not have distinct margins. Rather, small projections appear to pass from them into the surrounding interstitial tissue and fat. The more mature tissue, which is usually arranged in dense contracted bands, varies from white to yellow. The surface is glistening, and in very dense contracted areas, even has a translucent glary appearance. Usually the distal palmar and digital fascia is more involved than that in the proximal portion of the palm. We have, however, had several patients in whom one or more prominent bands of contracted fascia ran proximally as far as the transverse carpal ligament.

The proliferative and contracted stages of the disease may involve any of the vertical septa which pass from the palmar aponeurosis to the deep or pre-osseous fascia. Tendons, vessels, and nerves may be surrounded or angulated by these masses of tissue. In no instance did we note invasion of the sheaths of the flexor tendons. Nerves may pass through a mass of diseased fascia, but the nerve appears to have been surrounded rather than invaded, since it can always be freed from the contracted fascia by careful dissection. In the fingers the disease appears to involve only the digital fascia of the proximal and middle phalanges. Flexion contracture of the distal interphalangeal joint or extension of the disease beyond the proximal one-half of the middle phalanx was not observed in our patients. Occasionally, the distal interphalangeal joint may be hyperextended or even dislocated dorsally. This is usually seen in severe contractures if the patient has been forcing a tool between the palm and the contracted finger.

Microscopic Pathology

There has been little disagreement about the gross changes in Dupuytren's contracture. The major dissension today concerns the description of the microscopic changes, and in particular, the interpretation which is placed upon these changes. Although earlier observations of the histopathology of Dupuytren's contracture were reported, Langhans in 1887 provided the first exact description of the microscopic changes in this disease. He wrote that the histological changes at this site are essentially a process of new formation [of tissue] which runs off into the existing connective tissue. The cells of the aponeurosis and of the vascular sheaths are considerably increased in number and size.

Anderson in 1891 described hyperplasia of connective tissue which he believed was an inflammatory response. This process was considered to have begun in the fatty and fibrous tissue of the subcutaneous layer, then involving the palmar fascia by migrating along the blood vessels. Nichols in 1899 described his microscopic observations. He also interpreted the disease as connective-tissue hyperplasia.

Janssen in 1902 described fibrous-tissue proliferation arising from multiple foci. He pointed out the microscopic similarity between the proliferating fibrous tissue of

Dupuytren's contracture and that of fibrosarcoma. He concluded that the disease was proliferative, but neither inflammatory nor neoplastic. He felt that the disease could not be considered fibroma because of its diffuse and widespread distribution. Davis and Finesilver recorded a translation of Janssen's conclusions: "braidlike hypertrophy of the connective tissue, which originates in the walls of the smallest vessels and which ends in contraction." Coenen in 1918 wrote that the disease was due to a chronic inflammation, while Ledderhose in 1897 and again in 1920 described the fibrous-tissue proliferation, but did not consider it inflammatory.

Krogius in 1920 advanced the theory that Dupuytren's contracture is due to growth and contracture of the remnants of primitive embryonic muscles, the flexores breves manus superficiales. This theory has never been supported. Skoog in 1948 reviewed the embryology of the palmar fascia. He was unable to find any suggestions of primitive muscle developing in the palmar aponeurosis.

Iklé in 1928 rarely observed signs of inflammation, in the form of lymphocytic infiltration. He described the fibrous-tissue proliferation and noted the suggestion of neoplasm. He felt that the lesion was neither neoplastic nor inflammatory. Iklé concluded that the disease was a chronic hypertrophy of fibrous tissue resulting in fibrosis of the palmar fascia. Boehme observed definite development of thick-walled capillaries resembling angiomatous tissue, relaxation of the elastic fibers, and endothelial changes in the small veins.

Meyerding and associates in 1941 recorded their observations on specimens of the palmar fascia in sixty-one cases of Dupuytren's contracture in fifty-seven patients. In all cases in which overlying skin was available definite pathological changes were noted in it, and in the early stage, before any contracture occurred, the skin was bound down tightly. The changes in the skin were chiefly in the reticular and papillary zones where increased connective tissue was noted. Sweat glands were surrounded by fibrous tissue and lymphocytes in less advanced cases, but in advanced cases, they were rare or absent. In twenty-four of their fifty-seven patients there was "definite lymphocytic infiltration of the skin or subcutaneous tissue." Infiltration was noted to precede fibrosis. The lymphocytes and new capillaries were more numerous in the areas of unchanged fat cells. New capillaries and perivascular inflammation were almost entirely lacking in the palmar fascia itself. On the basis of these observations Meyerding concluded that the disease began as a perivascular inflammation in the interstitial tissues of the palm, and secondarily involved all of the structures of the palm, including the palmar fascia.

Horwitz in 1942 reported histological examinations in thirty-five cases of Dupuytren's contracture. He concluded that the disease was a benign fibroplasia of the palmar connective tissues. Clay in 1944 concluded that the disease is a neoplasm—a fibroma of the palmar fascia. Broadbent in 1955 described enlargement of pacinian corpuscles in hands affected by Dupuytren's contracture. Reflex neurovascular changes in the hand associated with enlarged pacinian corpuscles were considered to be of interest, but no definite etiological theory was advanced. Skoog, in 1948, in his classic monograph on Dupuytren's contracture, summarized the most prominent pathological descriptions in the literature and added his own observations. He examined twenty-nine specimens. In addition, electron microscopy was carried out on nine specimens. The nodules of hypercellular connective tissue were regarded as the initial stage of the disease and as pathognomonic for it. At the site of new-nodule formation rupture of aponeurotic fibers was found. Iron pigment was found in the cellular areas. Skoog concluded that Dupuytren's contracture begins when the fibers of the palmar aponeurosis are ruptured. The ruptured fibers then heal by proliferation of fibrous tissue. The proliferating tissue gradually undergoes all the stages of maturation of connective tissue until a mature, contracted, scarlike stage is reached. The iron pigment was said to represent minute hemorrhages which occurred at the time of the rupture of the fibers.

Warren in 1953 reported the examination of seventy-seven specimens of hands affected with Dupuytren's contracture. He noted chronic inflammatory cells in forty-four but not in thirty-three specimens. Inflammatory cells had perivascular distribution in forty-two of the forty-four specimens in which they were present. Warren suggested that the chronic inflammatory cells were the result and not the cause of fibroplastic proliferation. New actively growing vessels were noted. The distribution of proliferating fibrous tissues suggested proliferation at the periphery to Warren. He concluded: "the conception of this lesion as a benign neoplasm of palmar fascia best explains the clinical and pathological processes."

From the survey of the literature it can be seen that there are four major concepts concerning the histopathology of Dupuytren's contracture: (1) benign hyperplasia of fibrous tissue arising in the palmar aponeurosis; (2) inflammatory changes arising in the interstitial connective tissue of the palm and secondarily involving the aponeurosis; (3) benign neoplasm—fibroma; and (4) cellular hyperplasia in response to rupture of the collagenous fibers of the palmar aponeurosis.

MATERIAL

Specimens from sixty-one of our patients were available for examination. We were unable to correlate the degree of involvement of the palmar fascia or the maturity of the hyperplastic fibrous tissue with the age, sex, or occupation of the patient.

Histopathology

When the mature contracted bands of tissue are examined, one sees a mass of dense collagenous tissue. The fibers are quite thick and closely packed in parallel bundles. The individual fibers are straight as if under tension. The nuclei are elongated and lie compressed between the collagenous fibers. They are between ten and twenty times as long as they are wide. They stain so intensely with the nuclear stains that no nuclear detail can be seen. The over-all appearance is not unlike that of the normal aponeurosis except for a decrease in number of nuclei (Fig. 1). We have interpreted this stage, as have others, as the mature contracted stage of the disease. Regardless of the pathogenesis of the disease, this is the final stage. We were not able to demonstrate any areas of mature collagenous fibers either in the uninvolved aponeurosis or in the mature contracted bands, where we thought the appearance suggested rupture of the fibers.

When attention is turned to the more cellular areas of the diseased fascia, proliferation of fibrous tissue is seen. In those areas which we have interpreted as the most recent areas of proliferation, the nuclei are large and oval in shape, approximately two to three times as long as they are broad. The nuclear membrane is distinct and the nuclei are pale. A nucleolus is easily visible, stained somewhat more intensely than the remainder of the nucleus, which is finely granulated. Occasionally fine darker strands of material are visible within the nucleus. Mitotic figures are rare even in the most actively proliferating areas (Figs. 2 and 3).

The cellular margins are indistinct and cannot be identified. Between the large, plump nuclei there is a fibrillar network, made up of very fine fibrils arranged in a haphazard fashion. In hematoxylin and eosin preparations this fibrillar network stains light lavender. This type of cellular growth may be found arising in several different foci within one section and in different places in the palmar fascia.

The actively proliferating tissue has, in many areas, a nodular arrangement. Skoog interpreted these small actively proliferating nodules as the earliest stage of the disease. Warren noted that some of these early nodules appear to be proliferating at the periphery. We did observe this in some instances, but not with enough regularity to say that such a pattern was consistent. The tissue at the periphery of the nodules of proliferating tissue blends into the surrounding more mature fibrous tissue without any sharp demarcation

(Fig. 4). There is no suggestion of capsule formation around any of these proliferating areas. At times small elongated projections of the proliferating tissue appear to be arising from the nodule and pushing out into the mature collagenous fibers.

In nine of our sixty-one specimens we observed iron pigment in the center of hypercellular areas (Figs. 5 through 8). In hematoxylin and eosin preparations this pigment is golden brown and finely granular. It may lie in the intercellular spaces or within cells which appear to be phagocytic. This pigment stains positively for iron with Prussian blue. As far as we can determine this was not described before Skoog reported the presence of iron pigment in his 1948 monograph. We have not been able to find any subsequent reports of iron pigment in the hypercellular areas of tissue affected by Dupuytren's contracture.

Perhaps iron pigment has not been reported more frequently because it is difficult to find. A careful search of actively proliferating areas at a magnification of 400 diameters

FIG. 1

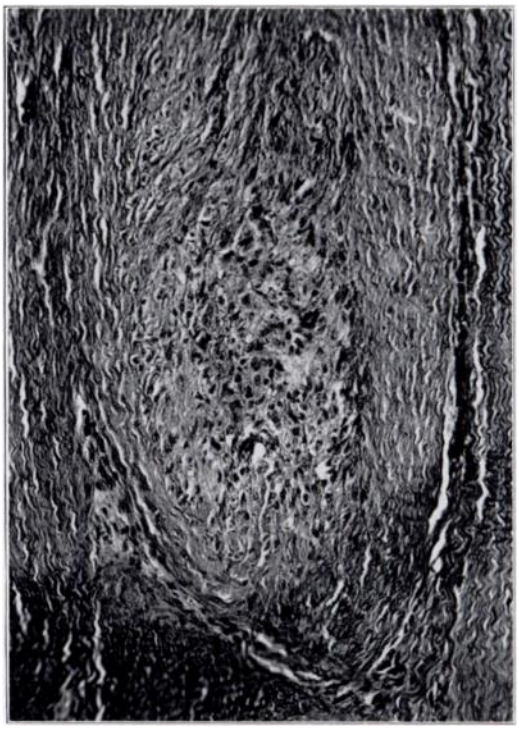

FIG. 2

Fig. 1: Photomicrograph of a longitudinal section made through a band of mature fibrous tissue (hematoxylin and eosin, × 90).

Fig. 2: Photomicrograph (× 135) showing a nodule of actively proliferating fibrous tissue. This is the earliest stage of Dupuytren's contracture.

or more is necessary. At lower powers the pigment is easily passed over. Iron pigment is observed only in the nodules of actively proliferating tissue. Perhaps no more than nine of the sixty-one specimens were observed to have iron pigment because not all specimens contained the proliferating tissue. It must be noted, however, that many nodules are to be seen which do not have iron pigment. Presumably it is not found in the more mature stages of the disease because it was removed by phagocytes. Iron-pigment deposits were observed neither in the mature contracted scar nor in the normal aponeurosis.

We were unable to demonstrate rupture of aponeurotic fibers at the site of fibrous-tissue proliferation. Observations after preparation with Masson connective-tissue stain suggested rather that the collagenous fibers of the aponeurosis were pushed aside by

masses of proliferating fibroblasts (Fig. 9). The fibrils about the immature fibroblasts are very fine. As the nodules undergo maturation into more mature fibrous tissue the fibrils become more dense and thickened. The fibrils of the proliferating nodules blend without sharp demarcation into the mature collagenous tissue. Study of tissue prepared with Verhoeff's elastic-tissue stain indicated that the new fibrils are not elastic tissue (Fig. 10).

Associated with the areas of proliferating tissue there is an increase in vascularity. Numerous areas of actively growing capillaries are noted.The capillaries are present both within and at the periphery of the nodules of proliferating tissue (Fig. 11). At the periphery of the nodules one often observes numerous thick-walled blood vessels which are much larger than the capillaries. The nuclei are round or oval rather than flattened and elongated, as is usually seen in endothelium. A great deal of nuclear detail is visible and cellular margins are more distinct. Frequently surrounding these vessels are one or more layers of concentrically arranged cells with oval or round nuclei. These vessels cannot be con-

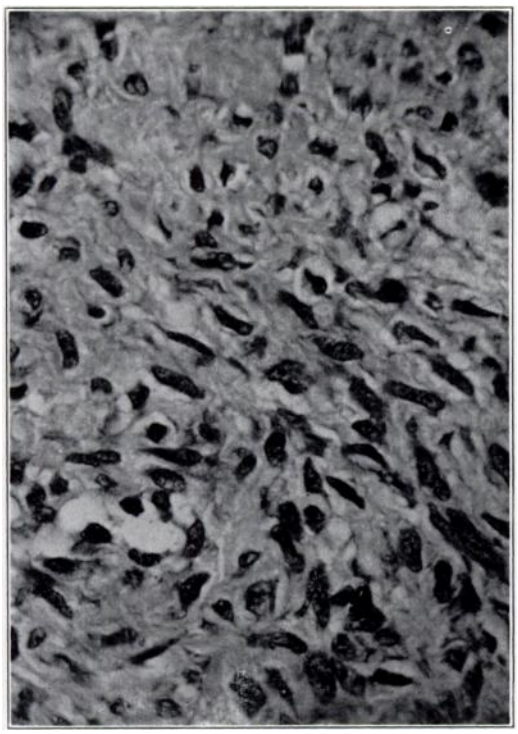

FIG. 3

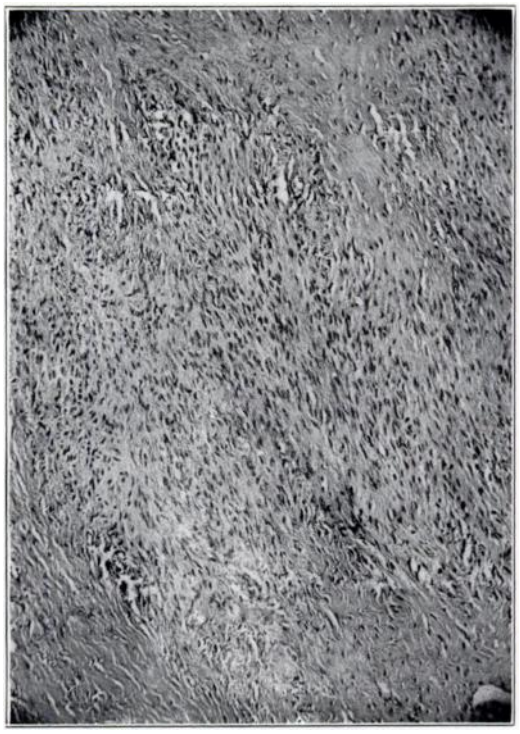

FIG. 4

Fig. 3: Photomicrograph of actively proliferating fibrous tissue. These areas are interpreted as the early lesions of Dupuytren's contracture (hematoxylin and eosin, × 400).

Fig. 4: Photomicrograph shows that proliferating fibrous tissue blends imperceptibly into the more mature fibrous tissue. Note the absence of capsule formation (hematoxylin and eosin, × 90).

sidered peculiar to the disease since they are noted in the normal aponeurosis (Fig. 12). We have the impression that they are increased in number in tissue affected by Dupuytren's contracture, but cannot demonstrate this conclusively.

Often at one point in the wall of such a vessel there may be a great increase in cellularity. These areas blend insensibly into the proliferating fibrous tissue of the lesion. These changes are apparently quite similar to those which were originally described by Langhans. There is no inflammation around the small vessels (Figs. 13 and 14).

Perivascular collections of inflammatory cells were observed in sixteen of the sixty-one specimens. The inflamed vessels are usually in the fatty or interstitial tissue around the palmar fascia (Fig. 15); an inflamed vessel within the aponeurosis itself was observed

once (Fig. 16). While we removed as little fat as possible in excising the palmar fascia, there was some fat present on all specimens. The inflammatory cells around the vessels were usually small lymphocytes. Occasionally the typical nucleus of a monocyte was observed.

As previously mentioned, the proliferating fibrous tissue blends, without sharp demarcation, into the surrounding mature fibrous tissue. It is possible to trace the evolution of the young growing tissue into mature dense collagenous tissue. The nuclei elongate and stain more deeply and the nuclear detail becomes obscured. The staining of the intercellular fibrillar network changes from lavender to the red orange usually associated with eosin-staining of collagenous tissue. The fibrils begin to assume a more regular distribution and finally become closely packed parallel mature collagenous-tissue fibers. At the same time the haphazard arrangement of the nuclei changes. They become arranged in sheets with their long axes oriented more or less in the same direction.

FIG. 5

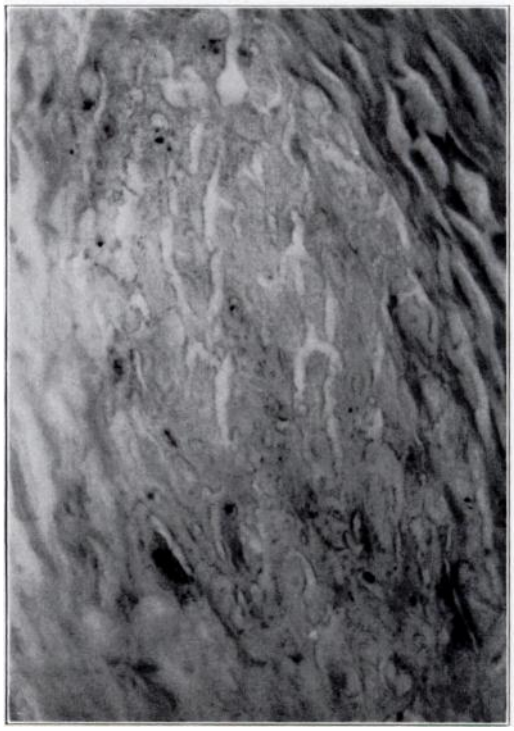

FIG. 6

Fig. 5: Same nodule as shown in Fig. 2. The fine black granules (A) are iron pigment stained blue. Note how easily this would be overlooked at ordinary magnifications, particularly if the nuclei were stained (Prussian blue, eosin counterstain, × 135).

Fig. 6: Same nodule as that in Fig. 5 (Prussian blue, eosin counterstain, × 600).

As maturation progresses the vascularity decreases. In more mature nodules the abundant capillaries cannot be identified. As the mature collagen-tissue stage is reached, the increase in vascularity is no longer present.

Pathogenesis

Perivascular accumulation of chronic inflammatory cells was noted in only sixteen of sixty-one specimens. Meyerding [39] observed this in twenty-four specimens from fifty-seven patients. Warren observed it in forty-four of seventy-seven specimens. The perivascular inflammation was noted to be in the fatty and interstitial tissue of the palm. Inflammatory cells were found about a vessel in the palmar fascia only once. In no instance

were the inflammatory cells observed around the vessels within or near the actively proliferating tissue. These observations lead us to conclude that perivascular inflammation is a result of fibrous-tissue proliferation within the palmar aponeurosis and not the cause of the proliferation. The inflammation may be a direct result of the proliferation or it may be present because the contracted areas of the palm are subjected to increased irritation.

The question naturally arises: why consider only nine instances of iron-pigment deposits as significant while discounting the importance of sixteen instances of perivascular inflammation? The perivascular inflammation is observed to lie outside the aponeurosis. In no instance were vessels near or within areas of proliferating tissue inflamed. On the other hand, iron-pigment deposits were found only in the earliest lesions of the contracture. It seems, therefore, that iron-pigment deposition is more closely associated with the early lesions of Dupuytren's contracture than is perivascular inflammation.

(The term *early* as used here refers to the stage of maturation of the fibrous tissue in

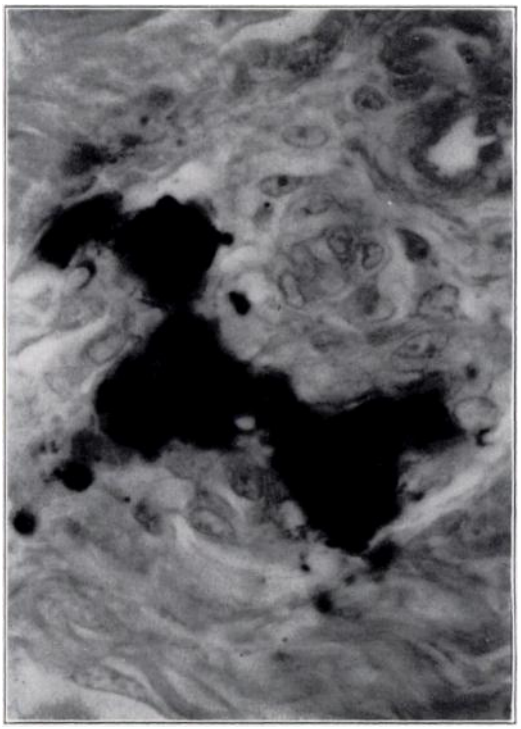

FIG. 7

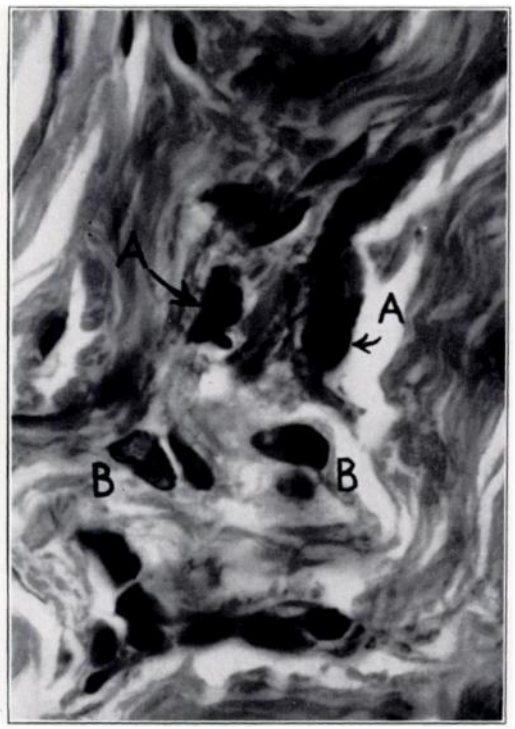

FIG. 8

Fig. 7: Young nodule of fibrous tissue with pronounced iron-pigment deposits are shown in photomicrograph. These deposits appear blue in the stained section (Prussian blue, eosin counterstain, × 800).

Fig. 8: Photomicrograph showing very early fibrous-tissue proliferation. The material (*A*) is blue in the section and represents iron pigment, while the young nuclei (*B*) are purple (Prussian blue, hematoxylin and eosin counterstain, × 1100).

the specimen and has nothing to do with the chronological history of the patient's disease. At times immature nodules of fibrous tissue containing iron pigment are found in the palmar fascia of patients who have had the contracture for several years. Other patients who have the iron pigment and the immature nodules had the contracture for only a few months. This probably means that in those patients in whom proliferating tissue containing iron pigment was found we had interrupted the contracture during one of its active proliferating phases, while in those patients in whom this type of tissue was not found, the contracture was relatively quiescent when operated upon.)

Skoog does not record the number of times he observed iron pigment in the twenty-nine specimens he examined. An incidence of only nine positive observations in sixty-one

specimens is insufficient evidence on which to base a pathogenic or etiological theory. It is not clear whether the iron pigment is associated with the cause of the lesion or is a result of the presence of the lesion. The presence of the iron pigment certainly suggests old hemorrhage associated with the actively proliferating fibrous tissue. Evidence of hemorrhage causes one to consider trauma as the cause of the hemorrhage. We are unable at this stage of our studies to formulate a pathogenic theory which either includes or excludes trauma. We do feel, however, that the subject is by no means a closed issue. Clearly, more work is necessary in this field.

The proliferating areas appeared to be invading the mature collagenous tissue without encapsulation. The similarity between the microscopic appearance of Dupuytren's contracture and fibrosarcoma has often been noted, but metastasis has never been reported. Certainly this is not a malignant fibrous-tissue neoplasm. If Dupuytren's contracture be a benign fibrous-tissue neoplasm, it is a most unusual one. Moore wrote, "the fibroma is a

FIG. 9

FIG. 10

Fig. 9: Note that in this photomicrograph the nodule of proliferating tissue appears to displace mature fibers. There is no suggestion of rupture of mature fibers (Masson connective-tissue stain, Gomori's trichrome counterstain, × 135).

Fig. 10: Photomicrograph of control material containing elastic tissue shows dense black elastic-tissue fibers with this stain. Note that in this specimen from a patient with Dupuytren's contracture there is no new formation of elastic tissue (Verhoeff's elastic-tissue stain, × 135).

circumscribed, encapsulated, usually lobulated tumor. . . ." No suggestion of encapsulation has been found in our specimens, nor have we found any reported in the literature. In addition, several areas of proliferating fibrous tissue are observed within one hand, and even within the same section. This implies a more or less simultaneous multicentric origin. Because of the lack of encapsulation, the multicentric origin of the proliferating tissue, and the diffuse distribution of the disease, we do not think that this is a benign neoplasm in the ordinary sense of the term.

We did observe large pacinian corpuscles in our specimens, but were unable, on anatomical grounds, to attach pathogenic importance to them.

We have concluded that the pathological changes in Dupuytren's contracture should be described as follows: there is an active proliferation of young fibroblasts in intimate association with numerous thick-walled vessels. There is an increased capillary vascularity. The proliferating tissue forms non-encapsulated nodules of varying size within the aponeurosis. Perivascular inflammation of vessels in the fatty and interstitial tissue around the aponeurosis occurs frequently. These nodules of tissue gradually undergo all of the well known changes from young, cellular, immature fibrous tissue into mature, contracted, dense, collagenous tissue. As the maturation progresses, the vascularity decreases. The cause of these changes is unknown, but does not appear to us to be inflammation or neoplasia. The process can best be described as fibroplasia or fibromatosis of unknown etiology. The significance of iron pigment in actively proliferating nodules needs further investigation.

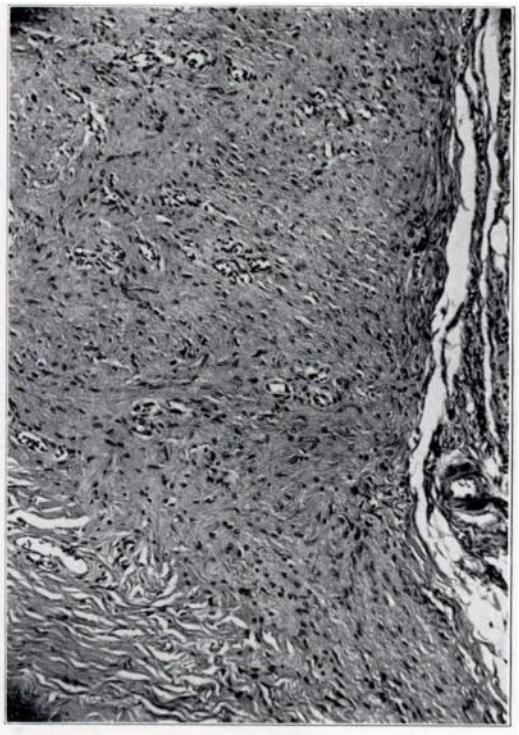

FIG. 11

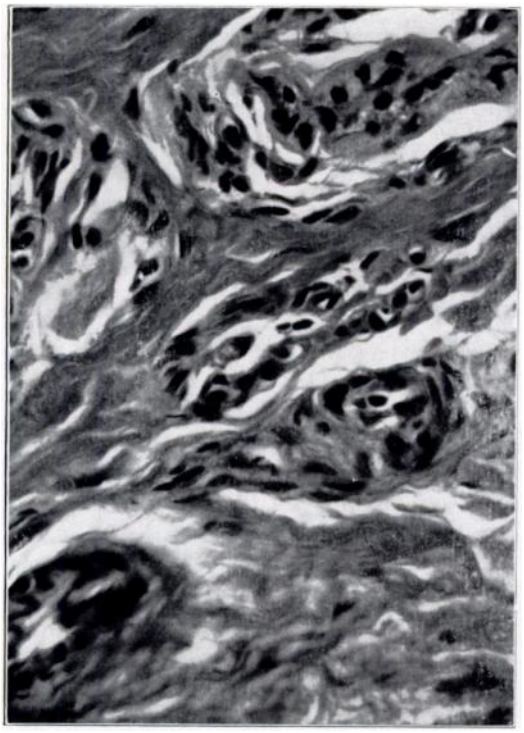

FIG. 12

Fig. 11: Photomicrograph of area of proliferating tissue affected with Dupuytren's contracture. Note marked vascularity within and at periphery of the nodule (hematoxylin and eosin, × 90).

Fig. 12: Photomicrograph showing thick-walled vessels in the palmar fascia. These vessels are seen both in normal fascia and near the periphery of proliferating nodules (hematoxylin and eosin, × 400).

TREATMENT

Non-operative Treatment

To discuss non-operative treatment of Dupuytren's contracture with local injections of pepsin [22], fat solutions [50], fibrolysin [36], copper sulphate [23], and pancreatic extract [47] would serve no useful purpose. The weight of responsible opinion now holds these methods to be without value. Cortisone was also found to have no effect upon the disease [3].

Treatment with oral tocopherol has been reported to improve Dupuytren's contracture [51, 52]. We have had an opportunity to observe the effect of alpha-tocopherol, 300 milligrams daily for three weeks, followed by 100 milligrams daily for several weeks, on three patients. We felt that there was a temporary softening of the contracture, but the

progressive course of the disease was not altered. Two of these patients subsequently had surgery.

Hydrocortisone acetate has been injected into the palm by Zachariae and Zachariae. They noted a temporary softening of the contracture in early cases, but did not believe that hydrocortisone would halt the progression of the disease. Howard, Pratt, and Bunnell injected hydrocortisone in the wound at the time of closure after operation for Dupuytren's contracture. Their patients had almost no postoperative pain. We have had no experience with hydrocortisone in either the non-operative or postoperative treatment of Dupuytren's contracture.

Radiation therapy has been used in the treatment of Dupuytren's contracture. Finney[17,18] treated fifty-nine patients with roentgen therapy. Twenty-five were treated with gamma radiation and thirty-four with medium-voltage x-ray. He noted a lessening of the feeling of tightness of the palm within one and a half months. Maximum improve-

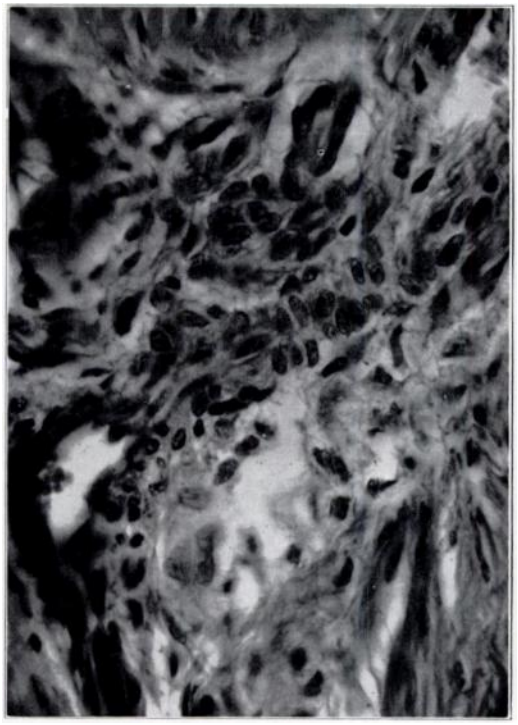

FIG. 13

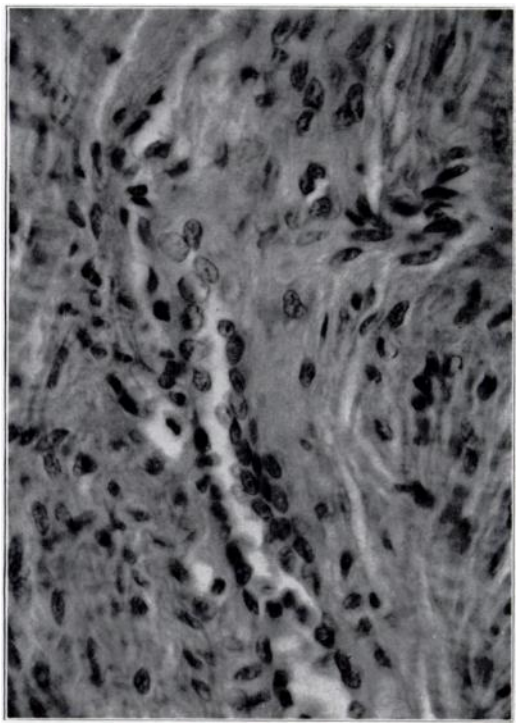

FIG. 14

Fig. 13: Photomicrograph of a thick-walled vessel with perivascular tissue blending into the proliferating nodule (hematoxylin and eosin, × 400).

Fig. 14: Photomicrograph of a longitudinally cut vessel. Note how the proliferating tissue of the lesion appears to arise from the perivascular tissues (hematoxylin and eosin, × 400).

ment in function usually occurred within six months. Of twenty-five patients treated with radium, fifteen showed a good functional result. Only eighteen patients treated with x-ray were evaluated; eight of these had a good functional result. Finney suggested a combination of preoperative irradiation and surgery for more advanced cases. We have had no experience with radiation in Dupuytren's contracture, but feel that the percentage of cases which showed a good functional result in Finney's series is less than might be expected from proper surgical treatment.

Surgical Treatment

The majority of those most experienced in the care of this condition agree that the

most effective treatment is surgical[5, 8, 11, 49]. There are three generally recognized types of operation for this disease. There often exists some question, however, about what type of operation should be performed in a given case. Fasciotomy, or simple division of the contracted bands, is the simplest operative procedure; it is done upon the contracted bands under direct vision or blindly with a cataract knife. Excision of the diseased fascia with varying margins of uninvolved fascia is the next simplest procedure, a limited or partial fasciectomy. Finally, there is a more radical operation in which all recognizable palmar fascia, together with the vertical septa which pass to the pre-osseous fascia and the pre-tendinous bands extending into the fingers is excised.

In our series, seventy-four of the ninety-nine patients (eighty-nine hands) were operated upon. The youngest patient operated upon was twelve years old, the oldest, seventy-eight. The average duration of the symptoms before surgery was 4.6 years.

Surgery is by no means indicated in all cases of Dupuytren's contracture. There is

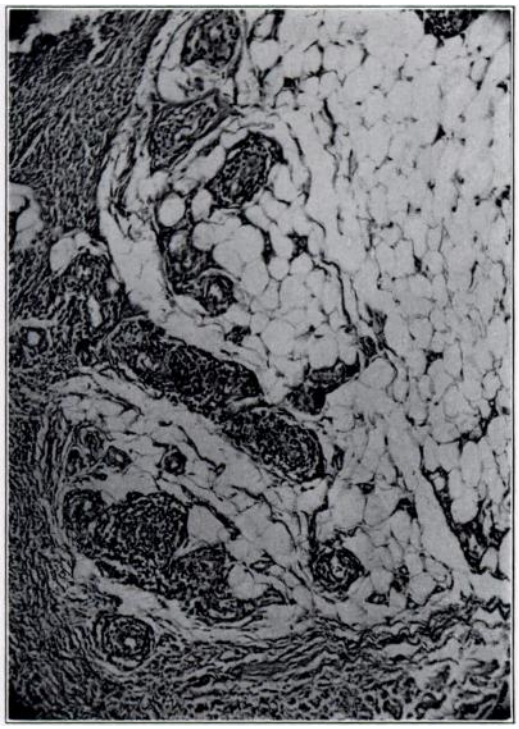

FIG. 15

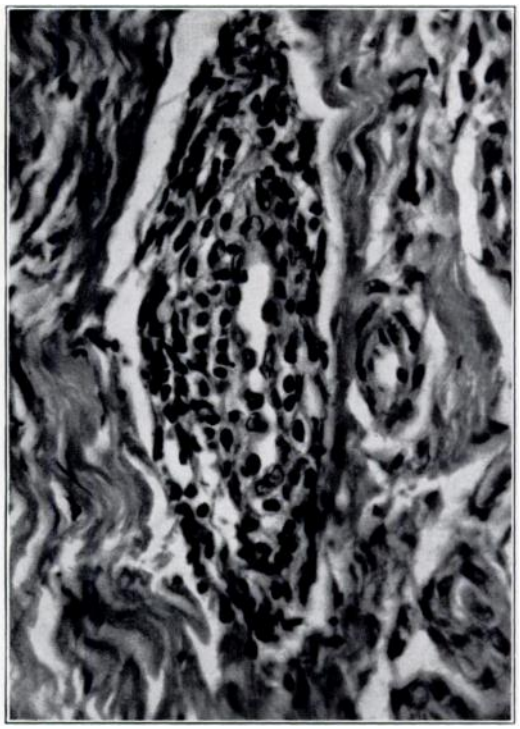

FIG. 16

Fig. 15: Photomicrograph showing perivascular inflammation in the fat near the palmar fascia. The inflammatory cells are predominately lymphocytes (hematoxylin and eosin, × 90).

Fig. 16: Photomicrograph showing perivascular inflammation within the palmar fascia. This finding is uncommon (hematoxylin and eosin, × 400).

no doubt that many patients with established contractures of moderate to severe degree require surgical relief. This is particularly true when the contracture is interfering with the patient's ability to carry on with his occupation. When to operate and whether or not to operate on a patient with the earlier stages of the disease pose a more difficult problem. Probably many patients never seek formal medical advice about their Dupuytren's contracture, getting along perfectly well without any treatment.

It is not possible to forecast accurately the progression or rate of progression of the contracture in any one patient. One would not like to operate upon a patient with mild contracture if it were certain that the disease would remain stationary at that point. On the other hand the operation is technically easier and the results are better when the

contracture is in a relatively early stage. When the contracture has existed so long that there are permanent joint changes, a perfect result is difficult to obtain. When it is not certain that an operation is indicated, observation of the patient for a few months is helpful. If the contracture is progressing rapidly operation is then recommended. If it remains stationary, and the contracture is in the earlier stages, surgery is not required.

From a review of the literature and our own experience we have concluded that the operation must be fitted to the individual patient. Factors which must be considered in determining the type of operation include age, general physical condition, associated diseases, occupation, stage of the disease, and the type of hand. A hand with marked arthritic changes does not stand extensive surgery well, as does not a thick broad hand with stubby fingers and some degree of stiffness, often seen in laborers. The choice of operation must also be influenced by the tendency of the contracture to recur if an inadequate excision be performed. Four of the patients in our series were operated upon for a recurrence of the disease after an operation done elsewhere.

Fasciotomy has been advocated as a preliminary operation in severe cases in preparation for more radical procedures (Figs. 17-A, 17-B, and 17-C). The preliminary operation allows stretching of the skin as well as gradual readjustment in other tissues and an opportunity to gain increased joint extension before the definitive operation. We have carried out preliminary fasciotomy three times. Two of these patients have returned for further surgery and the contracture is progressing in the third patient. Fasciotomy as the sole treatment of the disease is limited to those patients in whom more extensive procedures are contra-indicated. This includes the very elderly and those patients who have an associated disease which prevents extensive surgery. Fasciotomy is practicable in such patients only if the disease be manifested by prominent contracted longitudinal bands. We have used fasciotomy as the definitive operation twice, once in a man seventy-eight years old, and once in a man sixty-four years old, in whom radical fasciectomy on the other hand was done at the same time.

We have not performed blind or subcutaneous fasciotomy since we feared injury to the digital nerves in the palm. Bunnell and Boyes have performed subcutaneous fasciotomy in the palm, but caution that it is a dangerous procedure in the fingers.

Partial fasciectomy was practiced by Kocher in the latter part of the nineteenth century. Recently interest in this operation has been revived, particularly by Conway and Hamlin. Skin slough is a feared complication in all operations for Dupuytren's contracture. There is less chance of producing avascular skin flaps in a partial excision of the aponeurosis than there is in a total excision of that structure. Hamlin was impressed by the decreased postoperative morbidity when the limited operation was performed. Some patients, however, had postoperative stiffness in our series. The difficulty here is inability to flex the fingers rather than loss of extension. Stiffness may involve fingers which were not originally involved in the contracture. Postoperative stiffness was our most frequent complication of surgery. Usually the patients were able to work this out with the help of exercise and physical therapy although in some it persisted.

Partial fasciectomy, excision of the obviously contracted fascia with a narrow margin of normal fibrous tissue around the contracture, was performed by us on twenty hands. In six hands this was done through a sinuous longitudinal incision in the palm. Usually these patients had one prominent longitudinal band of contracted fascia and the rest of the palm was free of the disease. Two of these twenty patients who had partial fasciectomy had poor results: one due to prolonged stiffness and the other to persistent flexion deformity of the finger. One had a good result limited by slight flexion deformity of one finger. The remaining seventeen had excellent results. We have seen no recurrence in these patients, although several of them have not been followed long enough to preclude the possibility of recurrence.

Radical or total excision of the palmar fascia was employed in sixty-four patients;

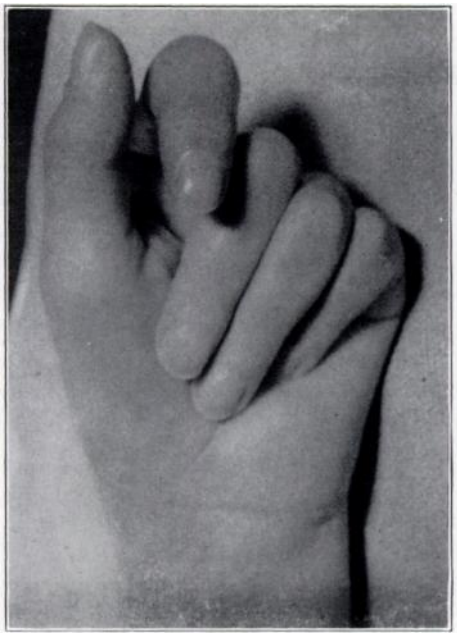

FIG. 17-A

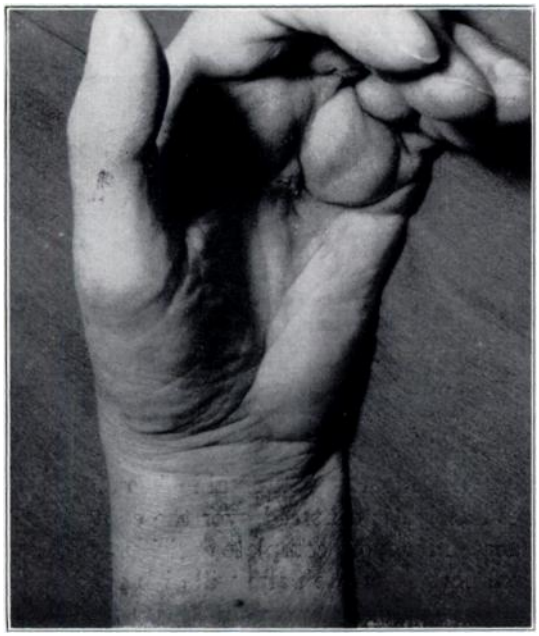

FIG. 17-B

Fig. 17-A: Preoperative photograph of the hand of a housewife forty-eight years old with severe Dupuytren's contracture.

Fig. 17-B: Photograph shows patient's ability to extend fingers after preliminary fasciotomy; definitive fasciectomy is pending.

Fig. 17-C: Artist's sketch of fasciotomy.

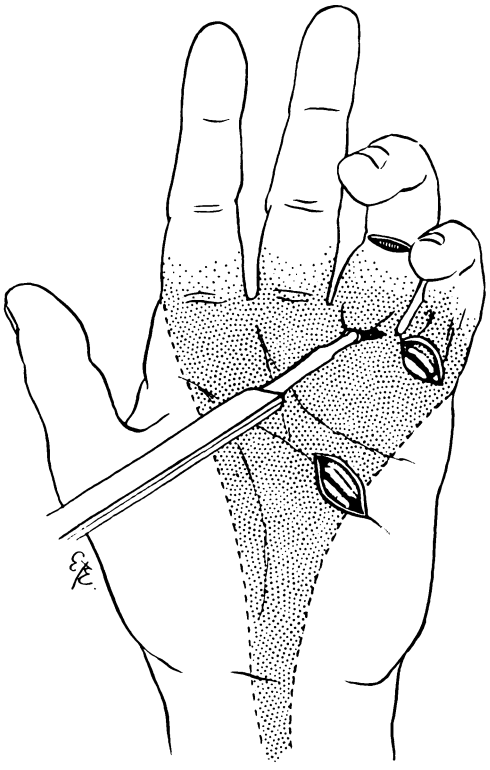

FIG. 17-C

partial fasciectomy, in twenty; definitive fasciotomy, in two; and preliminary fasciotomy, in three. In two patients excision of a finger nodule only was done. In eight patients skin-grafting of the wound was necessary because the contracture had irreparably damaged the overlying skin. Contracted bands and nodules of diseased fascia in the fingers were removed through appropriate incisions. A mid-lateral incision was used in sixteen instances; transverse incision in the finger creases, in twelve instances; L-flap incision, in ten; oblique incision, in five; Z incision (McIndoe), in three; and a bayonet incision, in one.

The palmar incisions employed in these operations included six sinuous longitudinal incisions and four L-flap incisions. Twenty-eight had a combined transverse incision in the distal palmar crease and oblique incision in the thenar crease; forty-nine had a single transverse incision in the distal palmar crease; and two had no palmar incision.

General anaesthesia was used during the operation unless it was contra-indicated. We found that brachial block anaesthesia tends to wear off before the operation is concluded. In addition, brachial block anaesthesia, while rendering the hand painless, fre-

quently does not relieve the pain produced by the tourniquet. The operation was always performed in a bloodless field, secured by a wide pneumatic tourniquet inflated to a pressure of 280 to 300 millimeters of mercury. The finger incisions were varied to meet the needs of the individual situation.

Small transverse incisions in the flexion creases of the fingers may be used for fasciotomy and also for excision of small discrete nodules on the anterior surface of the finger. Usually a more adequate exposure in the finger is needed. An oblique incision beginning in the mid-lateral line at the proximal interphalangeal joint and passing obliquely across the proximal phalanx will give good exposure. The proximal portion of this incision must not cross the finger web, as pointed out by Mason [37].

Mid-lateral incisions on the side of the finger give adequate exposure if the contracture is limited to one side of the finger. Flaps may be elevated, if necessary, by incising the skin of the flexion crease over the proximal interphalangeal joint. We have had limited experience with the Z incision described by Skoog and attributed to McIndoe, but we have found it satisfactory.

The sinuous longitudinal incision in the palm can be used only for partial fasciectomy. This incision is centered over the contracted longitudinal band. Transverse incisions are indicated for more complete excision of the fascia. A simple long transverse incision in the distal portion of the palm will give adequate exposure in most cases. If needed, a curved incision may also be made in the thenar crease. A bridge of subcutaneous fat and skin is then elevated between the transverse and thenar-crease incisions. The bridge of skin must not be too narrow or it will not have an adequate blood supply.

In elevating the skin flaps, careful sharp dissection with frequently changed knife blades is employed. All of the subcutaneous fat is elevated with the skin. Mason [39] pointed out the importance of preserving the small vessels which penetrate the fascia from below and supply the skin; we have paid close attention to this detail. After the subcutaneous fat is dissected away from the palmar fascia as far distally and proximally as possible, the fascia is divided transversely in the proximal portion of the palm. We did not think it necessary to reach the insertion of the palmaris longus, since the most proximal portion of the fascia is rarely involved in the disease.

The fascia is then dissected away from the deep structures of the palm. Kanavel, Koch, and Mason have emphasized the vertical septa which pass from the palmar to the pre-osseous fascia (Fig. 19). These septa pass between each flexor-tendon sheath and neurovascular bundle. They are frequently involved in the contracture and should be excised. They are excised as deeply in the palm as possible. Nerves may be surrounded or dislocated by masses of diseased fascia in these regions; consequently careful identification and retraction of each digital nerve is necessary in order to avoid injuring them.

After the dissection is complete, the tourniquet is released and all bleeding vessels are ligated. Absolute hemostasis in the palm and fingers is essential. The tourniquet is then reinflated. If the hand is elevated for a minute or two before the tourniquet is inflated most of the blood will drain out of the hand and forearm. If the bloodless field is then maintained until the wound has been closed and a compression dressing has been applied, there is less chance of wound hematoma. This is particularly important when a skin graft has been applied in the wound closure. The wounds are closed with fine monofilament-nylon suture. Small rubber tissue drains are placed in the wounds. A large compression dressing is held firmly over the wound by sutures as advocated by Tanzer and by Mason [37]. A voluminous compression dressing then covers the entire hand and forearm. An aluminum or plaster splint which holds the hand in position of function is incorporated into the dressing. The tourniquet is not released until the entire compression dressing and splint have been applied.

In eight of our cases so much palmar skin was irreparably damaged by the contracture and was excised that primary closure of the wound was not possible. Conway [12] found

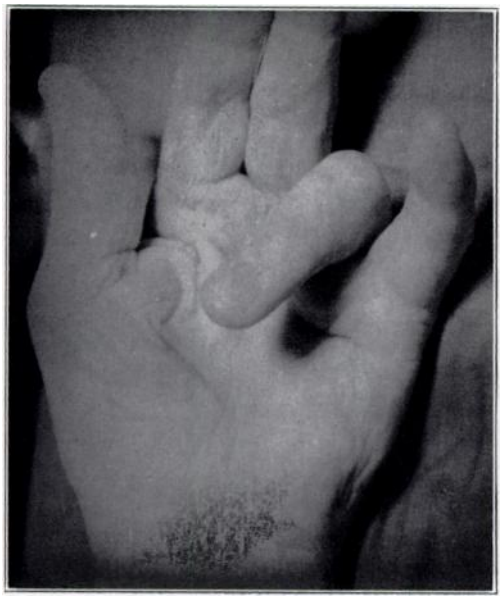

FIG. 18-A

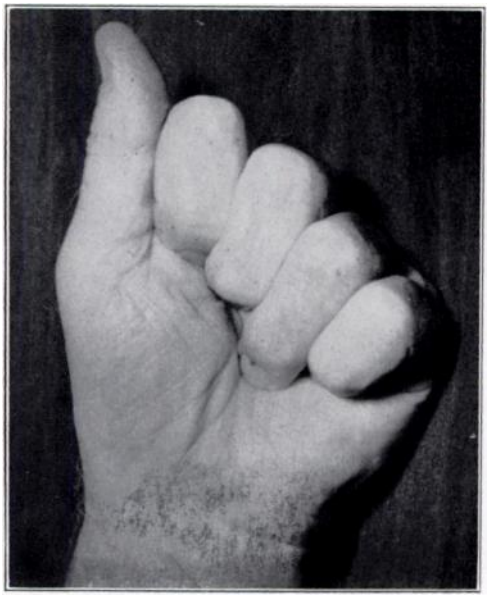

FIG. 18-B

Fig. 18-A: Preoperative photograph of the hand of a male office worker, seventy-eight years old.

Fig. 18-B: Photograph shows patient's ability to flex hand following definitive fasciotomy.

Fig. 18-C: Patient's ability to extend hand.

FIG. 18-C

thick split-thickness free grafts to be usually satisfactory. We have used grafts which we consider almost full thickness (.022 to .025 inch) taken from the thigh with an electric dermatome. These donor sites do not heal readily; consequently they are covered with thin split grafts taken in the same way from an adjacent area. We have not had occasion to use the method of dorsal-flap grafting described by Bruner.

In the postoperative period the hand is maintained in elevation either on pillows when the patient is in bed, or in a sling tied with the hand quite high on the chest when the patient is ambulatory. The large gauze dressing sutured over the palm may be removed on about the fourth day for removal of drains. Skin sutures are not removed in less than ten days. The hand is held immobile in the position of function until all of the wounds are completely healed. Following that, daily warm handbaths are started and the patient is encouraged to begin moving the hand. Gradually increasing exercise is instituted. Most patients are allowed to return to work in about four weeks.

RESULTS

Eighty-nine hands were operated upon in seventy-four patients. All of the operations were performed between 1949 and 1956. The longest follow-up in the series is seven years. The shortest follow-up is six months, excepting three patients who are regarded as operated upon too recently to evaluate and two patients who were lost to follow-up. The mean length of time which these patients were followed is 3.2 years; we have seen no recurrence

in this series. The length of time that the patients have been followed is too short to preclude the possibility of recurrence.

In evaluating the results of surgery one must consider the postoperative function of the hand, the duration of postoperative disability, and the ability of the patient to perform his usual work. We classed fifty-two hands as having an *excellent* result; extension returned to normal or nearly normal, there was no limitation of flexion, and the hand was free of pain. Twenty-two hands had a result classified as *good;* most of these were not in the excellent group because of slight residual stiffness. These patients were able to extend the fingers well, to carry on their usual work, were free of pain, but had slight persistent limitation of the last few degrees of finger flexion. Troublesome postoperative stiffness is encountered particularly in the following types of individuals: the elderly, those who have arthritis with restricted joint flexion preoperatively, and the laborer who has developed a thick, broad, stiff hand. These types of hands apparently do not stand trauma, including surgical trauma, well. This observation led us to employ more conservative operations in persons who have these types of hands. Five hands had *fair* results and five had *poor* results. Operative complications such as delayed healing in four hands; hematoma of the palm, in two; flexion contracture of the finger in four; and infection in one, contributed to these poor results. The only wound infection occurred in the patient with diabetes.

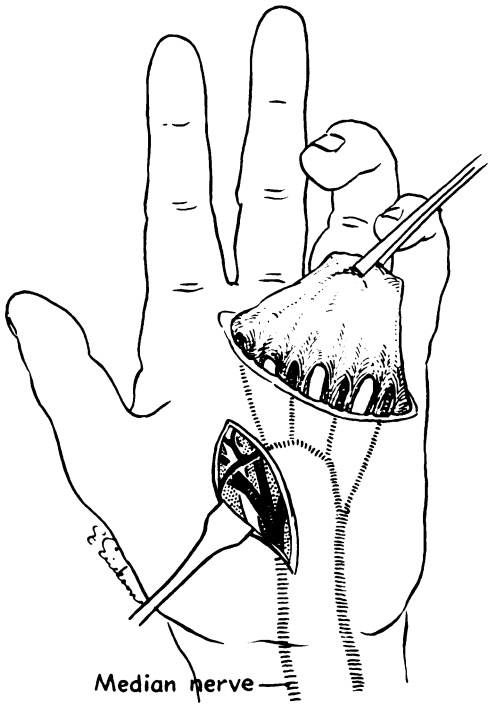

FIG. 19

Drawing shows complete excision of palmar fascia through incisions in the distal palmar and thenar creases. Note vertical septa passing from palmar to pre-osseous fascia, separating tendons and neurovascular bundles.

CONCLUSIONS

Dupuytren's contracture, 126 years after it was described by Dupuytren, remains a disease of unknown etiology. On the basis of histological studies of specimens from sixty-one patients, we conclude that Dupuytren's contracture is a fibrous-tissue proliferation arising within the palmar fascia in intimate association with thick-walled vessels together with an increase in capillary vascularity. This tissue undergoes the well known stages of maturation of fibrous tissue until a firm, relatively avascular, contracted scar is formed. The pathological changes do not suggest to us that the lesion is due to trauma, inflammation, or neoplasm. Further study is needed to determine the significance of iron pigment in the early lesions. Surgery is the only form of treatment which will produce any lasting benefit in this disease, although administration of tocopherol and irradiation may produce some temporary improvement. The operation must be fitted to the individual patient. Complete excision of the palmar fascia is indicated in most cases; however, partial excision of the fascia and fasciotomy have their place in selected cases. With proper choice of operation and careful attention to operative details excellent or good results can be expected in between 80 and 90 per cent of patients operated upon.

NOTE: We are indebted to Dr. Michael L. Mason, Chicago, Illinois, for allowing us to use his very fine file of articles on Dupuytren's contracture.

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DISCUSSION

DR. SUMNER L. KOCH, CHICAGO, ILLINOIS: The occasional presence of iron pigment is interesting, but may have a very simple explanation. Localized trauma with tearing of fibrous tissue and capillary hemorrhage must be a rather common occurrence in patients with firmly flexed fingers, and it is difficult to see how the presence of such pigment can serve to explain the cause of the fibrous-tissue formation.

In our experience Z-shaped incisions cannot often be successfully employed on the thickened and contracted palmar skin so often present. We have come more and more to use whole-thickness grafts to cover what often becomes a considerable defect when wide excision of fibrous tissue permits contracted fingers to extend. The important principle of compression in the treatment of wounds—surgical or accidental—needs constant re-emphasis. I believe that, along with careful cleansing, arrest of bleeding, and accurate surgical repair, it is the essential element in success.

DR. JULIAN M. BRUNER, DES MOINES, IOWA: In this very interesting paper, Dr. Larsen has touched upon an important fact, not previously emphasized, that in patients with Dupuytren's contracture stiffness of the hand after radical fasciectomy is apt to develop. This may occur after other radical surgery on the hand in patients of the same age group, but we have the impression that it is more common in hands affected by Dupuytren's disease. It is usually temporary but may persist, and if so, it is disabling.

Until we have some way of predicting or controlling this undesirable sequela, it may be said that radical fasciectomy, if routinely applied to all hands with Dupuytren's contracture, carries a known risk. In the authors' series twenty of seventy-four patients had trouble with postoperative stiffness of the hand. There-

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Electromyography confirms what Dr. Kaplan reported, that the action of the tensor fasciae latae is confined to the thigh and hip. It is mainly a flexor and medial rotator of the hip. I am not sure of its role in abduction. Although Dr. Kaplan found no abduction upon electrical stimulation of the tensor fasciae latae, electromyography reveals a very consistent response during abduction, one which has been reported by other observers. It may be that this represents a secondary activity, having a stabilizing influence during contraction of the glutaeus medius. This, I think, requires further study.

I doubt that the tensor fasciae latae acts synergistically with the glutaeus maximus in standing and walking. Most electromyographic studies indicate little if any activity of the glutaeus maximus during ordinary standing and walking. In other types of thigh or pelvis extension, however, the two muscles may well act synergistically.

Third, one other point must be considered. The function of the iliotibial tract is largely mechanical; however, it may also have a proprioceptive function. Superficial and deep nerves supply the tract, giving rise to pain and proprioceptive endings. The latter endings may well be stimulated during contraction of glutaeus maximus, tensor fasciae latae, biceps femoris, or underlying vastus lateralis, and may be a factor in reflex mechanisms during locomotion. There is no experimental evidence for this, however.

DR. KAPLAN (closing): There is not much to be added. My study of the anatomy and kinesiology of the tensor fasciae latae and the role of the iliotibial tract indicate that the role of the iliotibial tract is not fully understood.

In surgical division of the iliotibial tract for contracture, more than the tract alone is divided. In contractures producing abduction of the thigh, the cause cannot be assigned to one muscle or structure only, but to other muscles as well, of which the posterior third of the glutaeus medius in conjunction with the vastus lateralis is one of the important factors.

DISCUSSION

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fore it may be well to apply less radical forms of surgery in certain cases, namely localized fasciectomy or simple fasciotomy. The selection of treatment for the individual case requires good judgment.

DR. JOSEPH H. BOYES, LOS ANGELES, CALIFORNIA: How many have seen Dupuytren's contracture in the Negro or in the Oriental?

DR. H. W. MEYERDING, ROCHESTER, MINNESOTA: I have never operated on a Negro or an Oriental for Dupuytren's contracture. I was informed by a professor of surgery in India that Dupuytren's contracture is never seen in natives of that country.

DR. LARSEN (closing): In answer to Dr. Boyes' question, in the city of Detroit, which has a population of 1,910,000, and in the Greater Detroit area, with a population of 3,670,000, the Negro population is 375,000. We have found but two Negroes with Dupuytren's contracture, one man and one woman.