SOFT-TISSUE TUMORS OF THE SOLE

With Special Reference to Plantar Fibromatosis *

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Although Dupuytren, in his classic account of palmar fibromatosis, mentioned cases in which involvement of the plantar fascia was present, plantar fibromatosis has received scant attention in the 120 years which have passed since, as compared to that accorded this condition in the hand.

In contrast to the palmar lesions, which long have been regarded justly as benign, knowledge of the natural history of the lesion in the foot, to judge from the literature and from medical records, is vague. At times the lesion is regarded with suspicion; occasionally, it is believed to be frankly malignant.

Because the behavior of these lesions in the foot is poorly understood, we decided to review the records, in the files of the Mayo Clinic, of all soft-tissue tumors, both benign and malignant, involving the sole of the foot. We found sixty-nine cases of plantar fibromatosis and nine cases of malignant neoplasms of the soft tissues of the sole; these cases form the basis of this report.

REVIEW OF THE LITERATURE

Pickren and his coworkers, in 1951, reported a series of sixteen cases of plantar fibromatosis and were able to find reports of 104 cases in the literature. In addition to the cases included in their review, the authors have been able to find accounts of the following twenty-eight cases:

Meyerding and Shellito, in 1948, reported a series of twenty-four cases of plantar fibromatosis among 882 cases (2.7 per cent.) of Dupuytren's contracture seen at the Mayo Clinic over a twenty-year period. In the same year, Hammond and Dotter reported on a forty-year-old man who had bilateral involvement of both the feet and the hands.

Kapiloff and Prior, in 1952, reported two cases of plantar fibromatosis in children. One was an eight-year-old Negro boy in whom a tumor developed in the sole after an injury. The lesion was excised; in the succeeding sixteen months, three additional surgical excisions were performed for the persistently recurring lesion.

Keasbey, in 1953, reported four cases of fibrous tumors in the palmar and plantar fascia occurring in children. Three lesions were located in the palm and one in the sole. From the information given, we are of the opinion that these were cases of Dupuytren's contracture.

Pathology

The literature contains a number of brief descriptions of the pathological changes in Dupuytren's contracture in the hands and in the feet; however, no studies were devoted primarily to the pathological aspects of the lesion.

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Langhans, in 1887, described the essential pathological features of this lesion in specimens removed from the hand. He noted the areas of increased cellularity which characterize the lesion and expressed the opinion that the earliest change was increased vascularity with proliferation of perivascular fibrous tissue. In 1897, Ledderhose observed the same changes in Dupuytren's contracture involving the plantar fascia. Janssen gave an excellent description of the pathological anatomy and was probably the first to call attention to the fact that the histological appearance of actively proliferating areas may bear a strong resemblance to that in sarcoma. Janssen considered that the disease process was one of spotty hyperplasia. Iklé likewise was of the opinion that the condition was one of chronic hyperplasia, although he noted inflammatory features.

In 1941, Meyerding and his associates reported in detail the pathological findings in Dupuytren's contracture of the hands. They believed that the condition was best explained on the basis of chronic inflammation. Clay stressed the histological resemblance of the lesion to fibromata seen elsewhere in the body, especially desmoid tumors. Pickren and his coworkers stated that the histological picture observed in some cases of plantar fibromatosis could be interpreted as fibrosarcoma if it were found in other parts of the body, but that the process in the foot was clinically benign.

Relation of Plantar Fibromatosis to Fibromatosis Found Elsewhere

Kanavel and his associates found plantar involvement in two of twenty-nine cases of Dupuytren's contracture of the hand. In one case there was involvement of the thin fascial band which extends from the thumb to the index finger above and parallel to the web. The lesions in one other of their twenty-nine cases were noted on the dorsa of the fingers.

In a report concerning 361 epileptic patients (190 males and 171 females), Lund studied the occurrence of Dupuytren's contracture of the hands and of the feet, knuckle pads, "periarthrosis humeri", and Peyronie's disease. As a control group, he studied 1,021 brewery workers. He noted an incidence of Dupuytren's contracture of the hands at least four times greater in the epileptic patients than in the controls. Of the 361 epileptic patients, 50 per cent. of the males and 32 per cent. of the females had Dupuytren's contracture of the hands. Plantar fibromatosis was found in twenty-five of the 361 patients. These twenty-five patients consisted of twelve females and thirteen males. Plantar fibromatosis was noted in one of the controls. Of the 361 epileptic patients, twelve had "periarthrosis humeri". One hundred patients of each sex among the epileptics were examined for knuckle pads; this condition was found in twenty-nine males and thirteen females. Peyronie's disease was found in three of the 100 male epileptic patients examined for it.

Knuckle pads were present in twenty-two of Skoog's fifty patients who had Dupuytren's contracture of the hands. None of his patients had Peyronie's disease or keloids. Forty-three of these fifty patients who had palmar fibromatosis were examined for plantar involvement; ten patients, all of whom were men, had such lesions in the foot. He found knuckle pads in 35 per cent. of eighty-six epileptic patients who had Dupuytren's contracture of the hands and in 20 per cent. of 121 epileptics who did not have Dupuytren's contracture. Of 207 male epileptics, seven had Peyronie's disease; four of these had palmar fibromatosis, and one had involvement of both the palmar and plantar aponeurosis.

In a study of an unstated number of cases of Dupuytren's contracture of the hands, Bunnell found nine in which plantar lesions were also present. He encountered also eight instances of Peyronie's disease and five cases in which knuckle pads were noted. In one case a tight fibrous subcutaneous band extended down the front of the shoulder and the arm.

One instance of Peyronie's disease was found in the reports of the 104 cases of plantar fibromatosis by Pickren and his associates. Keloids were not noted in this group. In their

own series of sixteen patients, three had keloidal tendencies. None of the six males in this group had Peyronie's disease.

Meyerding and Shellito found associated palmar lesions in twelve of their twenty-four cases of Dupuytren's contracture of the foot.

Etiology

The number of factors which have been indicted singly or in combination as etiological possibilities in Dupuytren's contracture is truly varied and impressive. Skoog, in his review of the literature, listed the following general categories: (1) trauma; (2) neuropathy; (3) gout and rheumatism; (4) endocrinopathy; (5) faulty development; (6) contraction of the palmaris longus; (7) local infection; (8) tuberculosis; (9) chronic intoxication (chiefly lead poisoning); and (10) miscellaneous.

MATERIALS AND METHODS

As already indicated, a search of the files of the Mayo Clinic from 1907 through 1952 yielded sixty-nine instances of plantar fibromatosis and nine instances of malignant neoplasms involving the soft tissues of the sole of the foot.

Of the sixty-nine patients in whom diagnoses of plantar fibromatosis were made, thirty-five had had resective operations on the foot for this lesion. Of these, six patients also had had resection of palmar lesions. Pathological specimens were available from all these patients.

In two of the sixty-nine cases, specimens were taken at necropsy. In one of these, both the feet and the hands were involved and tissue was taken from both the palmar and plantar fascia. In the second case there was involvement of the left plantar fascia, with associated Peyronie's disease; tissue was taken from both sites.

Both plantar and palmar fascia was involved in nine of the sixty-nine cases, but resective surgery had been performed only on the hands; in four of these cases tissue was available for study.

In a total of twenty-nine cases in our study, specimens were available only from the involved plantar fascia; in seven cases specimens were available from both the feet and the hands, and in one case tissue was available from the foot and from the penis. In four cases specimens were available only from the hands. Thus, pathological specimens were available from the foot in thirty-seven of the sixty-nine cases of plantar fibromatosis, whereas specimens were available from the hand alone in an additional four cases.

In the thirty-two cases in which pathological material was not available from the feet, involvement of one or both hands was present. These cases are included on the basis of the clinical findings.

Surgical specimens were available in all nine cases of malignant tumors involving the sole.

The clinical records in each of the total of seventy-eight cases were abstracted, and follow-up letters were sent in all instances.

PLANTAR FIBROMATOSIS

Gross Pathology

The available specimens consisted of the excised portions of plantar fascia with attached fibrous tissue, fat, and, rarely, overlying skin. In nearly every specimen the plantar fascia was thickened by formation of a lobulated firm, irregular mass. The thickened zones consisted of multiple small nodules which merged with each other and with the fascial bundles (Figs. 1-A and 1-B). The individual nodules usually measured two to four millimeters in diameter but were occasionally larger; the largest discrete nodule was eight millimeters in diameter.

Fig. 1-A: Drawing showing the tumors in the arch of the foot and the clinical appearance of Dupuytren's contracture. (Reproduced with permission from: Dupuytren's Contracture of the Foot, by Henry Meyerding and J. G. Shellito. *Journal of the International College of Surgeons*, **11**: 596, 1948.)

Fig. 1-B: Exposure of the plantar fascia, demonstrating multiple nodules and thickening in Dupuytren's contracture. (Reproduced with permission from: Dupuytren's Contracture of the Foot, by Henry Meyerding and J. G. Shellito. *Journal of the International College of Surgeons*, **11**: 596, 1948.)

Fig. 1-C: The excised plantar fascia, showing an irregular tumor in the mid-portion of the specimen (actual size).

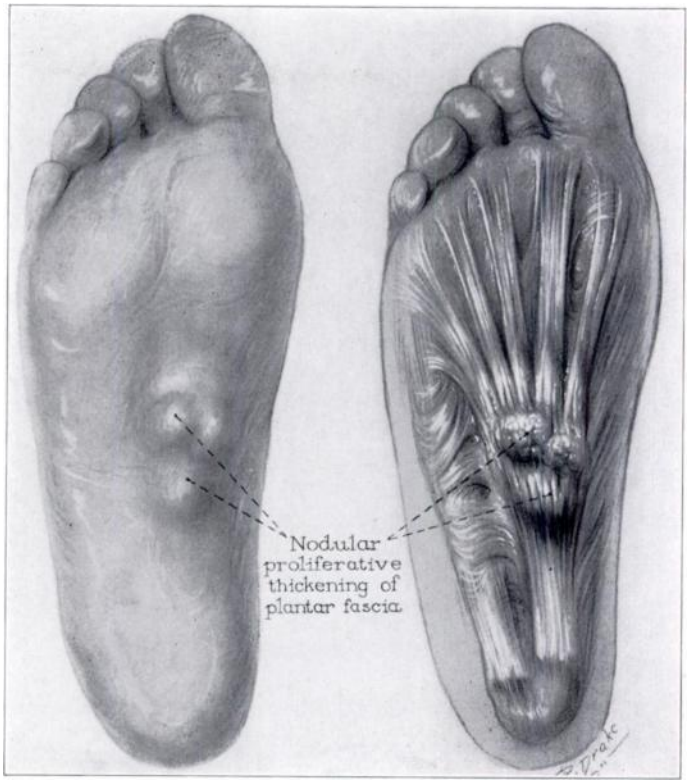

FIG. 1-A FIG. 1-B

A single specimen sometimes contained several thickened areas, each of which was composed of small nodules.

On cut section the tumor sometimes consisted of gray fibrous tissue within which fine bands and whorls could be seen. In other instances, the nodular portions consisted of sharply circumscribed zones of dull grayish-yellow tissue which contrasted rather sharply with the normal silvery, glistening bundles of fibrous tissue of the plantar fascia. When the fascia was sectioned parallel to the axis of its fibers, the glistening bundles of fibrous tissue could be followed to the affected portion. At this point the fascial fibers became distorted and compressed; sometimes they were interrupted by the nodules of tumor.

FIG. 1-C

The lesion was located in the longitudinal arch in thirty-eight of the forty-two cases in which the portion of plantar fascia involved was recorded. In two cases the nodules were located in the plantar fascia at the bases of the toes, along the heads of the metatarsals. In one case a nodule was located under the head of the third metatarsal bilaterally; involvement of the medial border of the left foot also was present. The lesion in one case appeared between the heads of the fourth and fifth metatarsals and presented on the dorsum of the foot, as well as on the plantar surface. With this single exception, all other lesions presented on the plantar surface of the foot.

The average size of the nodular, thickened areas was about 3 by 2 by 2 centimeters. The smallest excised mass measured 0.5 centimeter; the largest, 9 by 3 by 1.5 centimeters.

In most instances the growth presented clinically as a single nodule in the foot, in contradistinction to the multiplicity of nodules usually present in the hands. In seven

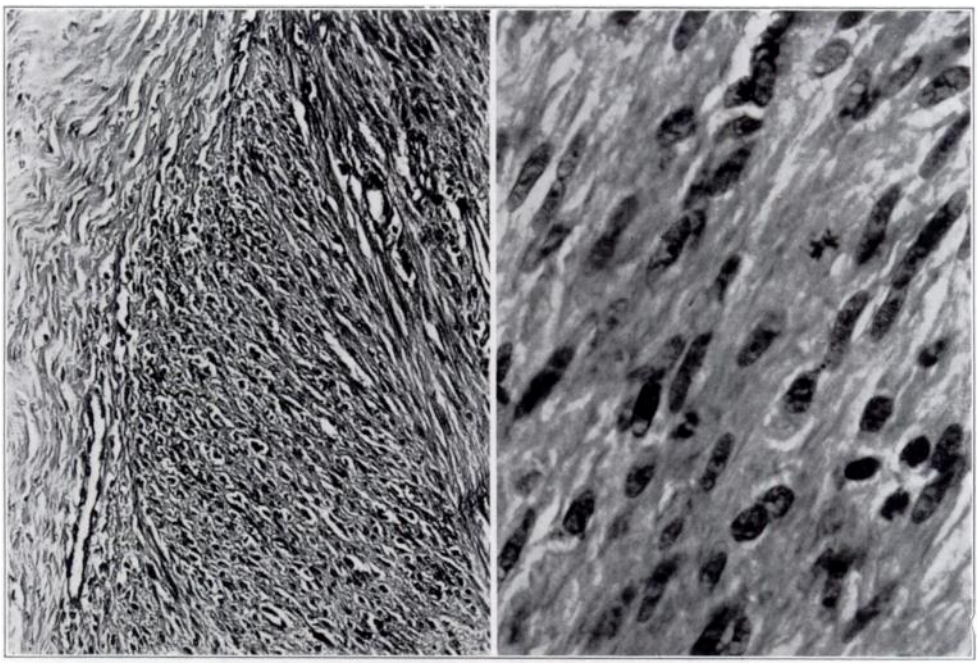

FIG. 2-A FIG. 2-B

Fig. 2-A: Photomicrograph (× 175; hematoxylin and eosin stain) showing proliferative nodule of average cellularity blending with normal fascia on the left.

Fig. 2-B: Photomicrograph (× 525; hematoxylin and eosin stain) showing the characteristic appearance of proliferating cells. Two mitotic figures are present.

cases, however, multiple nodules were present in one or both feet before surgical extirpation. An interesting finding in seven additional cases after excision of a single nodule was recurrence in the form of multiple tumors, usually in the region of the scar. Because of the irregular nodularity of the growth, it was not always possible to determine the limits of a single tumor. Moreover, it was easy to see how separate nodules coalesced to form a single mass.

The process did not tend to involve adjacent structures. In a single case the growth appeared to have developed within the substance of the tendon of the flexor hallucis longus. In two cases, in which previous operations had been performed, the masses were densely adherent to the skin and to the underlying muscles, nerves, blood vessels, and ligamentous structures. We did not find gross primary invasion into the muscles and deep structures of the foot, although occasionally the growth extended beyond the fascia into the adjacent fat and fibrous tissue. In some cases the skin was adherent to the underlying tumor.

Histopathology

The microscopic appearance of the lesion is so distinctive as to be diagnostic. The nodules seen grossly consisted of islands of proliferating fibroblasts which contrasted sharply with the relatively acellular collagenous aponeurotic background. In every instance examination under low magnification revealed a characteristic nodular, multicentric pattern of growth. Sometimes these proliferating foci were sharply separated from the adjacent compressed fascial bundles, which formed a pseudocapsule. Occasionally the nodules were discrete but blended gradually with the surrounding bundles, which were not compressed (Fig. 2-A).

Under higher magnification the cellular areas were seen to be composed of fibroblasts, with elongated fusiform or sometimes oval nuclei containing scant, finely vesiculated chromatin material, with one or two pale pink, small nucleoli (Fig. 2-B).

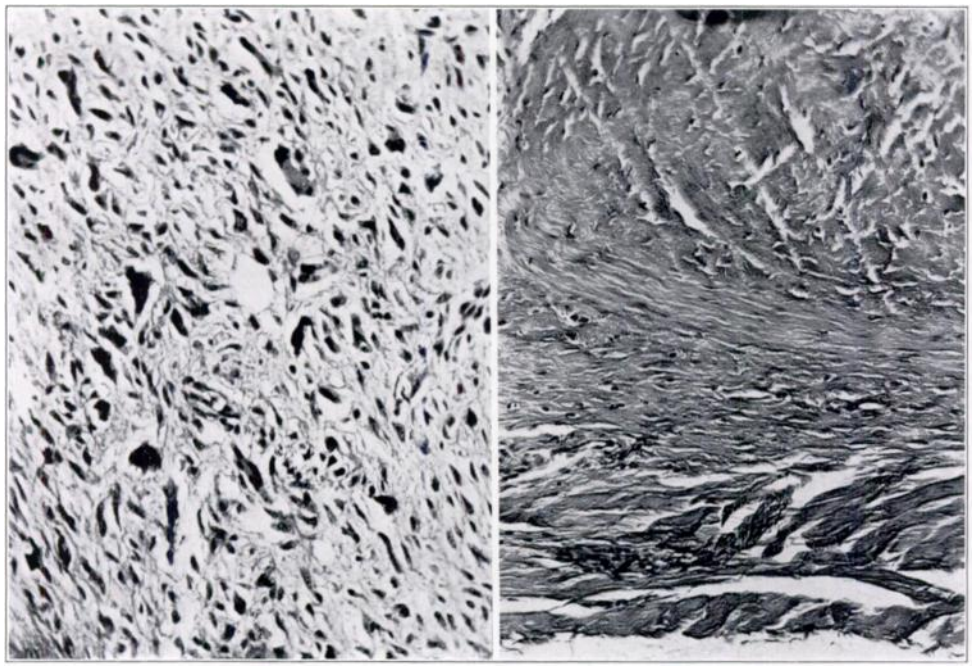

FIG. 2-C FIG. 2-D

Fig. 2-C: Photomicrograph (× 220; hematoxylin and eosin stain) showing a proliferating nodule with multinucleated cells and moderate variation in size and shape of cells.

Fig. 2-D: Photomicrograph (× 150; hematoxylin and eosin stain) showing the late stage of the disease. The proliferative nodule at the top is relatively acellular and is composed of dense collagen.

Collagen was present in the actively growing foci in every specimen; quantitatively, it usually was in an inverse ratio to the degree of cellularity. The collagen consisted typically of a loose network of fine fibers parallel to the axis of the proliferating cells. Variations in this appearance will be described later.

The proliferating fibroblasts generally varied little in size, shape, or staining reaction. However, the lesions in four of our cases were exceptions to this general rule, in that considerable variation occurred in these cytological features and multinucleated giant cells were fairly numerous (Fig. 2-C). These giant cells appeared to result from fusion of growing cells and the individual nuclei did not appear disproportionately large.

In most cases rare mitotic figures could be found after prolonged search. In the four cases mentioned, in which cellular variation was noted, mitosis was rather common; in one case, nearly every high-power field revealed two or three mitotic figures (Fig. 2-B).

In general, the nodules were highly cellular as compared to normal fascia (Fig. 2-A). In nearly every case we were able to find nodules ranging from highly cellular ones to some which were relatively acellular and composed mainly of dense and sometimes hyalinized collagen (Fig. 2-D). In these latter zones the collagen had lost its fine fibrillar structure and was easily distinguished from the normal fascial bundles, between which it was interposed. One lesion consisted entirely of dense hyalinized nodular tissue interposed between the fascial bundles. We were unable to correlate the presence of such areas with either the duration of the lesion or the age of the patient.

A nearly constant finding in our material was the peculiar relationship of the growing centers to blood vessels. Within the proliferative nodules themselves the blood vessels sometimes showed large hobnail-like endothelial cells which often appeared stratified. Often the shape of the lumen was irregular and slitlike because of invagination of proliferating tissue. More remarkable was the fact that plump fibroblastic cells surrounded the vessel and formed a cuff which was from two to eight layers of cells in thickness (Fig. 3). At times

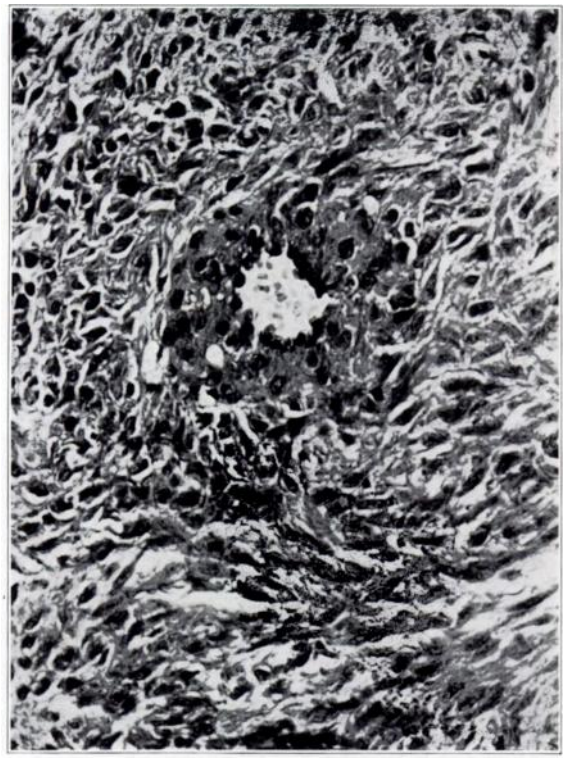

FIG. 3

Photomicrograph (× 330; hematoxylin and eosin stain) demonstrating the vessel within a proliferative nodule. The wall consists of a thick cuff of proliferating fibroblasts.

this feature formed a striking picture. In other cases only a few such vessels were observed. It was, however, a fairly constant and distinctive finding. Even more unusual, however, was the frequent presence of these peculiar vessels in normal fascia often well removed from the proliferative nodules. These peculiar perivascular cells sometimes appeared to be the origin of the proliferative nodules.

Another interesting feature, and one which has given rise to much controversy, was the finding of inflammatory cells; their presence was observed in nearly every case. Almost always they consisted predominantly of lymphocytes, but there were also mononuclear cells and occasional neutrophils. Characteristically the cells were perivascular in location and well away from the proliferative nodules. The vessels in these areas sometimes showed the proliferative cuffing already described. When accessory cutaneous structures were included in the section, these inflammatory cells were often seen surrounding sweat glands. Usually the inflammatory component of the lesion was not a striking characteristic, but in some specimens it was fairly pronounced. Only rarely did we observe a few scattered inflammatory cells within the foci of growth.

Skin was included in only a few specimens. Sweat glands were identified occasionally. The proliferating nodules were sometimes in close proximity, and in one case the sweat glands were surrounded by dense fibrous tissue.

In only one case was there evidence of invasiveness, demonstrated by inclusion of muscle cells within the proliferating tissue. It was difficult to interpret this feature, since four surgical operations had been done previously for this lesion. One of the sections in this same case showed a traumatic neuroma.

Clinical Data

The sex distribution in these sixty-nine cases of plantar fibromatosis was forty-three males and twenty-six females.

The age at onset was less than thirty years in twenty-four cases (35 per cent.). In two cases the lesion was present at birth. After the age of thirty the incidence of onset of the lesion showed a progressive increase in the fourth, fifth, and sixth decades of life (11, 16, and 24 per cent., respectively).

Involvement of the right foot only was present in eighteen cases, whereas the left foot only was involved in twenty-four; in twenty-seven cases the lesion was bilateral.

Twenty-three patients stated that they had noted pain. This varied in severity from infrequent mild pain after long standing or walking to pain which was severe enough to incapacitate the patient. Fourteen patients had not experienced pain. The records concerning thirty-two patients did not state whether or not pain was present; in these patients it may be inferred that pain was not present or was not prominent.

Recurrence after Surgical Excision

In twenty-eight cases a single excision only had been performed; the lesion recurred in fifteen of these cases. In five of the twenty-eight cases there was no recurrence. In the remaining eight cases it is not known whether or not recurrence took place.

Two excisions were performed in seven cases; known recurrence took place in four of these. In one case no recurrence was present seven years after the later operation and in another no recurrence was present four years after surgical treatment. It was not stated whether or not recurrence took place in the remaining instance.

The lesions were excised three or more times in three cases. In one of these cases the lesion was excised from the right foot three times within three months. When it recurred the foot was amputated. A lesion developed later in the opposite foot. In one case the lesion was excised four times within three and one-half years, yet it again recurred. Five excisions were done over a ten-year period in the third case; the lesion recurred and has persisted. These clinical data include three cases in which excision was done elsewhere, in addition to the thirty-five cases in which excision was done at the Clinic.

In seven cases, treatment with radium or roentgen rays, or both, was used in addition to excision; no apparent beneficial effect was noted.

The interval between surgical excision and recurrence was less than three months in eight cases, in two of which the lesions recurred almost immediately. In eight cases the lesions recurred six months to one year after operation. In four cases the lesions recurred between one and two years after excision. The interval was not recorded in two cases.

Course

The course of the disease is long and may extend over the patient's lifetime. We were especially interested in the course of the lesion when the onset was early in life. This series included eight patients who were less than twenty years of age when the lesion appeared. In only one of these, a seventeen-year-old girl, was the lesion bilateral; none of them had associated palmar lesions. Three cases are of special interest to illustrate the natural course of the disease.

A man, thirty-three years old, was seen at the Clinic in 1915, at which time a tumor was removed from the sole of the right foot. The lesion had been present since childhood. At the last follow-up, in 1952, the patient was seventy-one years of age. The lesion had recurred on the foot within one year after operation, but had given no further trouble. At present both hands are involved.

A man, twenty-three years old, had noticed a tumor in the sole of the left foot for about fifteen years. Within the year preceding admission he had noted similar involvement of the right foot and Dupuytren's contracture of both hands.

A thirty-year-old man had noted a tumor in the sole of the right foot since childhood. Involvement of the left hand had become evident seven years prior to admission, and one and a half years before admission lesions had been noted in the right hand. One year before the patient was admitted, a tumor had appeared in the sole of the left foot.

Association with Fibromatosis Elsewhere

In twenty-four cases the lesion involved the plantar fascia only and in each of these the diagnosis was proved histologically.

In forty-five cases both palmar and plantar fascia was involved. The order of occurrence was recorded in twenty-six of these cases. In fourteen of them the lesion appeared first in the hands. Ten years or more had elapsed before the lesion appeared in the feet in four cases, whereas five to ten years had passed in eight cases; in the remaining two cases the interval was four years.

In ten of the twenty-six cases in which the order of occurrence was noted, the lesions appeared first in the feet. In three cases the intervals before the lesions appeared in the hand were twenty, thirty, and forty years, respectively. In two cases the time interval was ten to twenty years. In three cases the interval was two to five years. In the remaining

two cases the lesions appeared in the hands less than one year after they had been noted in the feet, the intervals being two and two and one-half months, respectively.

In the remaining two of the twenty-six cases in which the order of occurrence was noted the lesions appeared simultaneously in both palmar and plantar fascia.

Penis plasticus (Peyronie's disease) was associated in three cases. In two of these there was involvement of the plantar fascia only, and in one there was involvement of both feet and both hands.

Knuckle pads were present in three cases, in all of which both the palmar and plantar fascia was involved.

Keloids were associated in four cases. In two of these both palmar and plantar fascia was involved, whereas only plantar fascial lesions were present in two.

Firm subcutaneous nodules were noted in ligamentous tissue elsewhere in two cases, in each of which involvement of both palms and both soles was present. Bilateral involvement of the tensor fasciae femoris was noted in one of these. In the second case firm subcutaneous nodules were noted over the flexor tendons of both wrists and in the tendons of both shoulders; knuckle pads were also present.

Desmoid tumors were not found in any of our cases.

Epilepsy was present in three of the sixty-nine cases. Craniotomy was performed in one of these and an intracerebral dermoid cyst containing hair and sebaceous material was discovered. The patient died after operation.

Comment

It is apparent that plantar fibromatosis has been mistaken in times past for a malignant neoplasm. In our series, a histological diagnosis of fibrosarcoma was made originally in eight cases; in two of these the diagnosis appeared to be corroborated clinically on the basis of rapid recurrence after operation. These erroneous diagnoses were made twenty years ago or more, before sufficient experience had accumulated to permit clinical and pathological definition of the lesion.

Amputation for this lesion was performed in only one of our cases.

A woman, fifty-eight years old, noted a tender mass in the right sole. This tumor was excised but recurred within two weeks. Excision was again performed and within one month the lesion had again recurred. At this time the foot was amputated. As indicated previously, six months later a similar nodule appeared in the left sole. Two years later this lesion was excised; follow-up examination fourteen years later showed no recurrence.

The actively proliferating nodules of fibroblasts, sometimes showing cellular variability, mitotic figures and, rarely, invasive properties, easily may be mistaken histologically for a malignant neoplasm. Nevertheless, we consider that the microscopic features are highly distinctive.

If the lesion is associated with palmar lesions or Peyronie's disease, or if both feet are involved, the diagnosis is almost certainly plantar fibromatosis. In the eight cases in our series in which an erroneous diagnosis of malignant neoplasm was made, the lesion affected one foot only in three cases, both feet in two cases, one foot and both hands in one case, and one foot and one hand in one case; involvement of one foot in association with Peyronie's disease was present in the eighth case. Clinically these lesions exhibit other features which may render it difficult to differentiate them from malignant neoplasms. The lesion may recur rapidly after excision. Excision of a single mass may be followed by recurrence in the form of multiple nodules. The lesion in plantar fibromatosis, like a malignant neoplasm, is sometimes adherent to the skin and in some instances to the deep structures of the sole of the foot.

Follow-up information in our series emphasized the fact that plantar fibromatosis is a benign process. No instance of metastasis was found, although many local recurrences of the lesions were noted in some cases. The duration of follow-up studies in this series

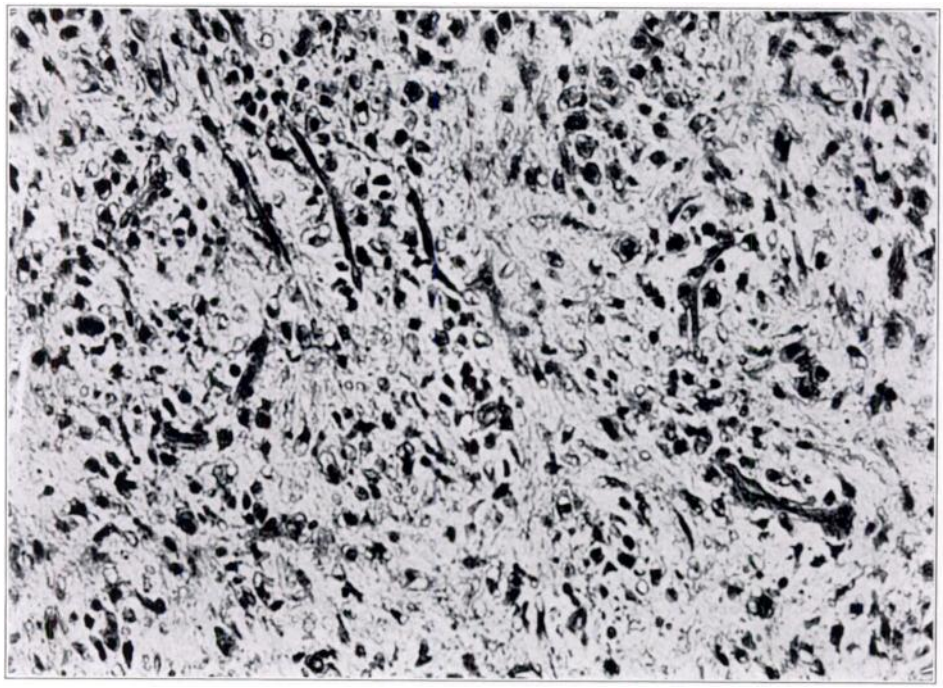

FIG. 4

Case 1. The specimen (× 250; hematoxylin and eosin stain) is taken from a liposarcoma of the sole. The neoplastic cells are large and vacuolated and contain sudanophilic material.

covered a period up to thirty-nine years; the period was more than five years in nineteen cases. In some cases, as already mentioned, the lesions appeared first in the foot, to be followed after a variable period by involvement of the fascia of one or both palms, the latter lesion admittedly being a benign one. We have been unable to find any evidence in the literature or in our series to indicate that plantar fibromatosis pursues the course of a malignant neoplasm.

MALIGNANT NEOPLASMS OF THE SOFT TISSUES OF THE SOLE

We have been able to discover only five reports of malignant soft-tissue tumors of the sole. In a report of fifteen cases of synovioma, Coley and Pierson, in 1937, described one case in which the lesion began in the sole.

Briggs, in 1942, reported a series of nine cases of synovioma, in one of which the lesion was located in the sole.

In 1940, Collins and Anspach reported on a nineteen-year-old man who, at the age of fourteen years, had noted soreness in the right sole; about one year later a swelling appeared. When he was sixteen years of age, a biopsy specimen was obtained and a diagnosis of fibrosarcoma was made; amputation was advised but was refused. Roentgen-ray treatment was given. Two years later biopsy of lymph nodes from the right groin revealed metastatic spindle-cell sarcoma. One year later widespread pulmonary metastasis appeared and the patient died.

Zarzecki reported a series of thirty-eight cases of fibrosarcoma of the extremities. In one case, in which death occurred, the tumor was located on the plantar surface of the foot.

Bennett reported a study of thirty-two synoviomata in 1947; he found one case in which the neoplasm was located on the sole.

In our material, the soft-tissue tumors presenting in the sole could be divided into two sharply defined categories, namely, the benign lesions, consisting entirely of plantar fibromatosis, and the malignant neoplasms. There were no instances of benign tumors

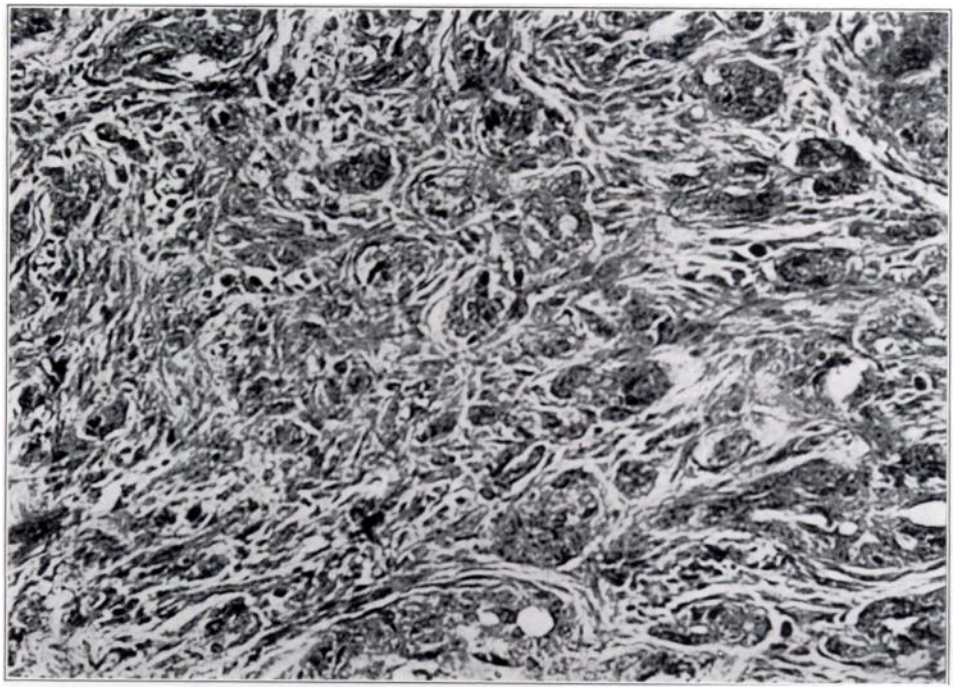

FIG. 5

Case 2. Specimen (× 250; hematoxylin and eosin stain) from a synovioma of the sole. The characteristic appearance of the glandlike spaces and the malignant fibrous-tissue component is shown.

arising from nerves, blood vessels, muscles, or other soft-tissue components. As indicated previously, we found nine cases of malignant neoplasms of the soft tissues of the sole.

REPORT OF CASES

CASE 1. A woman, sixty-five years old, had noted a tumor on the right sole for three years. The mass was not painful but interfered with wearing a shoe. The lesion had been excised one and one-half years before admission and again nine months before admission, but each time it had recurred soon after operation. Examination revealed a soft tumor in the sole; it measured four centimeters in diameter and was attached to the skin. The lesion was excised and was diagnosed histologically as liposarcoma (Fig. 4). Amputation was refused by the patient. The tumor had not recurred ten months after operation.

CASE 2. A man, thirty-four years old, first noticed a lump in the left instep nine years before admission; five years before admission the tumor was excised, but it recurred and grew slowly until eight months before admission, when it was again excised. The site of surgical excision had failed to heal, and a persistent draining sinus was present. Examination disclosed a soft tumor which measured six centimeters in diameter and occupied the entire mid-portion of the left sole. The foot was amputated at the ankle. The patient died of pulmonary metastasis one and one-half years later. The surgical specimen showed extensive involvement of the soft-tissue structures of the sole by the tumor. Histological examination revealed a synovioma (Fig. 5).

CASE 3. A man, forty-six years old, came to the Clinic because of a tumor in the arch of the right foot of fifteen months' duration. Six months before admission a two-centimeter tumor had been excised from the right foot; it recurred, grew rapidly, and was again excised three months later. Examination showed a soft, tender subcutaneous tumor measuring three centimeters in diameter and occupying the mid-portion of the right sole. A mid-thigh amputation was performed. The patient died one and one-half years later with roentgenographic evidence of extensive pulmonary metastasis. The surgical specimen showed extensive involvement of all the soft tissues of the sole by the tumor. Histological examination showed the tumor to be synovioma.

CASE 4. A man, forty-four years old, came to the Clinic because of swelling in the left sole of four years' duration. Six months before admission the foot had become swollen and painful and appeared fluctuant. The tumor was "lanced" without relief and a draining sinus had persisted. Examination disclosed a large, soft,

tender mass occupying the left sole. A below-the-knee amputation was performed. The patient died one and one-half years later with roentgenographic evidence of extensive pulmonary metastasis. The surgical specimen showed extensive involvement of all the soft-tissue structures of the sole by the tumor. Histological examination revealed a synovioma.

CASE 5. A sixteen-year-old boy came to the Clinic because of a tumor in the right sole of nine years' duration. Two years after onset the mass had reached a diameter of one centimeter; it was excised but was not examined histologically. Nine months before admission a painless mass had appeared in the right groin. Two weeks before admission this mass, which was the size of a walnut, had been excised and a diagnosis of sarcoma had been made. Examination disclosed an unhealed inguinal surgical incision. In the right sole was a firm, freely movable nodule measuring 1.5 centimeters in diameter; this mass was excised and was reported to be a sarcoma. Roentgen-ray therapy was given after operation. Six years later an abdominal mass and ascites developed and the patient died. Necropsy was not performed, but the patient was considered to have metastatic sarcoma. Histological examination of the tumor excised from the foot revealed a synovioma.

CASE 6. A man, twenty-seven years old, came to the Clinic because of a swelling of the right sole of six months' duration. The mass had become fluctuant and four days before admission had been incised, with drainage of what appeared to be purulent material. Examination revealed a large, soft, tender mass which occupied the entire mid-portion of the right sole. Roentgenographic examination showed destruction of the tarsal bones. Biopsy of the lesion revealed sarcoma and a below-the-knee amputation was performed; fifteen months later the patient died of pulmonary metastasis. The surgical specimen showed extensive involvement of the soft tissues of the sole and destruction of the tarsal bones by the tumor. Histological examination disclosed that the tumor was a synovioma.

CASE 7. A man, forty-eight years old, came to the Clinic because of a tumor of the left sole of unstated duration. Two years before admission a small tumor had been excised from the arch of the left foot and had been diagnosed as a fibroma; the tumor recurred almost immediately. Examination showed a large mass occupying the arch and most of the sole of the left foot. A below-the-knee amputation was performed. The patient died one and one-half years later of extensive pulmonary metastasis. The surgical specimen showed extensive involvement of the soft tissues of the sole by the tumor. Histologically the tumor was found to be a synovioma.

CASE 8. A man, forty-six years old, had noted three small nodules on the dorsum and a larger tumor in the sole of the right foot for six months. These had grown slowly. One month before admission one of the nodules had been excised and a histological diagnosis of sarcoma had been made. Examination revealed three firm nodules on the dorsum of the right foot and a larger tumor which bulged in the arch of the foot. Amputation through the lower portion of the thigh was performed. Thoracic roentgenograms revealed widespread pulmonary metastasis two and one-half years later. The patient was lost to follow-up. Histological examination showed that the tumor was a synovioma.

CASE 9. A thirty-year-old woman came to the Clinic because of a tumor in the left sole of two years' duration. The mass had grown slowly and was painful on walking and at night. Nine months before admission the tumor, which had reached a diameter of five centimeters, had been excised. Four months later a mass had reappeared and soon after similar, smaller nodules had appeared in the sole. The lesions were extremely painful. Examination disclosed a tender mass measuring five by seven centimeters and occupying the mid-portion of the left sole. The leg was amputated; one and one-half years later the patient died with the clinical diagnosis of metastatic sarcoma. Histological examination showed the tumor to be synovioma.

SUMMARY AND CONCLUSIONS

Sixty-nine cases of plantar fibromatosis and nine cases of malignant neoplasms involving the soft tissues of the sole form the basis of this study. Of the nine malignant neoplasms in this series, eight were synoviomata and one was a liposarcoma. The behavior of these tumors in the foot does not differ from that of such tumors elsewhere in the body.

In twenty-four of the sixty-nine cases of plantar fibromatosis in this series, the lesions involved plantar fascia only; in the remaining forty-five cases, both palmar and plantar fascia was involved. Peyronie's disease was found in three cases. Knuckle pads were present in three cases and keloids were associated in four. Firm subcutaneous nodules in ligamentous tissue elsewhere were noted in two cases.

The average age of onset of plantar fibromatosis was in the fourth decade of life. One third of the patients were younger than thirty years at the time of onset; the lesion was

congenital in two patients. There were forty-three males and twenty-six females in this series of sixty-nine cases of plantar fibromatosis. Following surgical excision in thirty-eight cases of plantar fibromatosis in this series, the lesion is known to have recurred in twenty-five cases, in most instances within one year after operation.

The course of plantar fibromatosis is apt to be long and only slowly progressive. In the great majority of cases the lesion is relatively asymptomatic. Pain is usually infrequent and mild.

Fibromatosis may be mistaken histologically for a malignant neoplasm on the basis of actively proliferating fibroblasts, cellular variability, mitotic figures, and, on occasions — especially after previous surgical treatment — apparently invasive properties. The histological features are diagnostic to the pathologist familiar with this lesion.

Plantar fibromatosis is a benign lesion. There is no evidence that the lesion ever becomes malignant.

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