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Soft-Tissue Tumors and Tumor-Like Lesions of the Foot

AN ANALYSIS OF EIGHTY-THREE CASES*

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ABSTRACT: The cases of eighty-three patients who had a soft-tissue tumor or tumor-like lesion in the foot or ankle were retrospectively analyzed to determine the relative frequency of the lesions and which factors, if any, could be used to identify them preoperatively. Seventy-two (87 per cent) of the lesions were benign, with ganglion cysts and plantar fibromatoses being the most common, and eleven (13 per cent) were malignant tumors, five (45 per cent) of which were synovial sarcomas.

The age of the patient and the location of the lesion were the two most important factors that characterized the malignant tumors. For eight patients (12 per cent), radiographs were helpful in identifying the nature of the lesion. The sex of the patient, a history of trauma, the duration of the symptoms, the size of the lesion, and the presence of pain or of neurological symptoms were not useful in discriminating a benign lesion from a malignant tumor.

While the majority of soft-tissue lesions about the foot or ankle are reactive or inflammatory in nature, some are true neoplasms. Even though primary sarcomas arising distal to the knee comprise only 8 per cent of the estimated 4,500 sarcomas that are discovered each year, and metstatic tumors at that location are rare, concern always exists as to whether or not a given lesion is a malignant process.

Numerous types of soft-tissue lesions are encountered in the foot. The World Health Organization classification system, as modified by Enzinger and Weiss, recognizes eighty-two distinct benign and malignant soft-tissue lesions and tumors of ten major histiogenic types that can arise in the distal part of the leg. Some of these, however, such as ganglion cysts and xanthomas, are generally not considered to be true neoplasms. In addition, several non-neoplastic lesions, such as epidermal inclusion cysts or rheumatoid nodules, may closely mimic true soft-tissue tumors. The large number of different histiogenic types, coupled with the low incidence, makes it difficult for a single physician or institution to gain a large clinical experience with tumors and tumor-like lesions of the foot and ankle.

It is well known that the initial treatment for a neoplasm, including management of the biopsy, greatly influences the final outcome of the patient. Therefore, the possibility, however remote, that a tumor is malignant must always be considered. In an effort to identify distinguishing clinical characteristics of soft-tissue tumors of the foot, we analyzed the cases of all patients having a tumor or tumor-like lesion that had recently been biopsied at our institution.

Materials and Methods

All patients who were seen at the Hospital for Joint Diseases Orthopaedic Institute between 1979 and 1984 who had a biopsy of a lesion of the foot or ankle were included in the study. The age and sex of the patient, location and size of the lesion, history of trauma, duration of the symptoms, presence or absence of pain and of neurological symptoms, and final pathological diagnosis were obtained from the patient’s hospital records for retrospective analysis. The available radiographs were reviewed for evidence of a soft-

![Fig. 1](image-url)

The zones of the foot that were used to analyze the data. The anatomical positions of the lines correspond to an oblique coronal plane, drawn from the mid-tarsal joint to the posterior margin of the longitudinal arch; a transverse plane, drawn from the mid-point of the metatarsal heads to the level of insertion of the Achilles tendon into the calcaneus; and a coronal plane, drawn through the metatarsophalangeal joints. These regions were numbered 1 through 5, to correspond to the ankle, heel, dorsum of the foot, plantar surface of the foot, and toes.

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TABLE I

DISTRIBUTION OF LESIONS BY HISTIOGENIC TYPE*

<table>
<thead>
<tr>
<th>Tissue Precursor</th>
<th>Benign Lesions (n = 72)</th>
<th>Malignant Tumors (n = 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrous</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fibroma (1)</td>
<td>Dermatofibrosarcoma (1)</td>
</tr>
<tr>
<td></td>
<td>Infantile digital fibroma (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plantar fibromatosis (11)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unspecified fibromatosis (2)</td>
<td></td>
</tr>
<tr>
<td>Fibrohistiocytic</td>
<td>Benign fibrous histiocytoma (1)</td>
<td></td>
</tr>
<tr>
<td>Adipose</td>
<td>Lipoma (6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lipoblastoma (1)</td>
<td></td>
</tr>
<tr>
<td>Smooth muscle</td>
<td>Leiomyoma (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Angiomyoma (2)</td>
<td></td>
</tr>
<tr>
<td>Vascular</td>
<td>Hemangioma (1)</td>
<td>Kaposi sarcoma (1)</td>
</tr>
<tr>
<td>Synovial</td>
<td>Pigmented villonodular synovitis (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Giant-cell tumor of tendon sheath (3)</td>
<td></td>
</tr>
<tr>
<td>Neural</td>
<td>Neurofibroma (1)</td>
<td></td>
</tr>
<tr>
<td>Cartilage/bone</td>
<td>Extraosseous chondroma (1)</td>
<td>Extraosseous myxoid chondrosarcoma (2)</td>
</tr>
<tr>
<td></td>
<td>Metaplastic cartilage/bone (2)</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Ganglion cyst (24)</td>
<td>Unspecified sarcoma (2)</td>
</tr>
<tr>
<td></td>
<td>Myxoma (1)</td>
<td></td>
</tr>
<tr>
<td>Tumor-like</td>
<td>Epidermal inclusion cyst (7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rheumatoid nodule (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Synovial cyst (1)</td>
<td></td>
</tr>
</tbody>
</table>

* Numbers of lesions are given in parentheses.

tissue mass, abnormal densities, calcification of the lesion, or secondary osseous involvement.

For the purpose of this study, the foot was divided into five regions, or zones (Fig. 1). Data on the site of the lesion were analyzed according to these regions.

The average age of the patients, size of the lesions, and duration of the symptoms; the female-to-male ratio; and the percentages of patients who had pain, neurological symptoms, and a history of trauma were calculated for both the benign-lesion and malignant-tumor groups. The incidence of the lesions by site and by age of the patients also was calculated. A table of the radiographic findings was prepared for each patient, taking care to note abnormal tissue densities, the presence of calcification, and any evidence of secondary osseous involvement.

Results

Type of Lesion (Table I)

Seventy-two (87 per cent) of the lesions were benign, and eleven (13 per cent) were malignant tumors. Thus, the ratio of benign lesions to malignant tumors was 6.5 to 1.

Ganglion cysts were the most commonly encountered benign lesions, accounting for nearly one-third of all of the total, followed in order of frequency by plantar fibromatoses, epidermal inclusion cysts, lipomas, rheumatoid nodules, and giant-cell tumors of tendon sheath. The remaining benign lesions were of many types, representing nearly all classes of histiogenic precursors.

Synovial sarcoma was the most frequent type of malignant tumor, comprising five (45 per cent) of the eleven malignant tumors and 6 per cent of the total of eighty-three lesions. The remaining malignant tumors were represented by only four histiogenic types.

Age (Fig. 2)

The average ages of the patients who had benign lesions and malignant tumors were not significantly different, but the benign lesions tended to occur in the middle decades; forty-seven (65 per cent) of the patients were between twenty and sixty years old. The malignant tumors occurred either between the ages of ten and forty years or after the age of sixty years. Although there were too few malignant tumors in this series to permit drawing any valid conclusions, the distribution of malignant tumors parallels that found by Simon and Enneking, indicating that sarcomas are very rare in the middle decades of life.

Sex

The female-to-male ratio of the patients was 1.6 to 1 for the benign lesions and 1.8 to 1 for the malignant tumors. Although some studies found a slight male predominance for soft-tissue sarcoma, the sex of the patient was of no use in predicting the nature of the lesion in our series.

Clinical Findings (Table II)

Antecedent trauma was reported by approximately 20 per cent of the patients; it was therefore a common (and often misleading) part of the history. Although pain was most common in the patients who had a malignant tumor, it was only slightly less common in those who had a benign
lesion and was not a useful discriminator between the two. Similarly, the sizes of the lesions fell mostly within an average range of one to three centimeters and were of no diagnostic importance.

Perhaps somewhat surprising was the duration of the symptoms. While it might be expected that a malignant tumor would be evident sooner because of rapid growth or other progressive symptoms, the patients who had a malignant tumor could trace the onset of the symptoms for an average of nearly one and one-half years. This duration did not differ significantly from that in the patients who had a benign lesion.

Neurological symptoms were exceedingly rare, being found in only one patient, who had a synovial sarcoma of the medial aspect of the hind part of the foot and symptoms of tarsal tunnel compression.

Zones of the Foot (Table III)

Thirty-three (40 per cent) of the eighty-three lesions were in Zone 3; nineteen (23 per cent), in Zone 1; fourteen (17 per cent), in Zone 4; and twelve (14 per cent), in Zone 5. Only five (6 per cent) of the lesions arose in Zone 2. On examining the distribution of the malignant tumors, however, it was found that two (40 per cent) of the lesions in Zone 2 were malignant, followed by three (16 per cent) in Zone 1, four (12 per cent) in Zone 3, one (8 per cent) in Zone 5, and one (7 per cent) in Zone 4. Thus, lesions in the heel (Zone 2) were more likely to be malignant, while those about the ankle (Zone 1) or on the dorsum of the foot (Zone 3) had a rate of malignancy approximating that of the group as a whole. Alternatively, lesions in the sole of the foot or in the toes were only occasionally malignant.

Some lesions had a predilection for a specific zone. Plantar fibromatoses accounted for ten (71 per cent) of the fourteen lesions in the sole of the foot (Zone 4). Ganglion cysts were seen throughout the foot, accounting for nearly one-half, or sixteen (48 per cent) of the lesions in Zone 3 and for six (32 per cent) of those in Zone 1. Synovial sarcomas tended to aggregate about the ankle in Zones 1, 2, and 3, although one of these lesions developed in the sole of the foot. Epidermal inclusion cysts were found mainly in the weight-bearing surfaces of the foot (Zones 2, 4, and 5), which is not remarkable, as these surfaces are the most susceptible to the penetrating injury that causes this lesion.

Radiographic Findings

For sixty-nine patients, the radiographs were available for review. Twenty-four (35 per cent) of these patients had a visible soft-tissue mass, and eight (12 per cent) had other findings. Of the patients who had a benign lesion, one had an unspecified fibromatosis with calcification; one, a lipoma with a lucent fat density; one, pigmented villonodular syn-
ovitis with subchondral bone cysts; and two, metaplastic bone and cartilage with calcification. Of the patients who had a malignant tumor, two who had a synovial sarcoma and one who had an extraosseous myxoid chondrosarcoma also had evidence of invasion and destruction of bone secondary to extrinsic pressure.

Very little computerized tomography and no magnetic resonance imaging had been done on these patients. We chose instead to concentrate on factors that could easily be evaluated in an office setting.

**Discussion**

The optimum treatment of a patient who has a soft-tissue sarcoma begins with a proper work-up and a correctly performed biopsy that does not limit further definitive procedures. Because of the rarity of primary soft-tissue sarcoma in the foot, often the diagnosis is made only after the surgical excision of a tumor that had been thought to be benign. There have been several reports on soft-tissue tumors arising in the hand and wrist, but very little has been written about tumors in the foot and ankle to aid the clinician in making this determination.

The sex of the patient, a history of trauma, the duration of the symptoms, the presence of pain or of neurological symptoms, and the size of the lesion were not useful discriminators between malignant tumors and benign lesions. On the contrary, the five synovial sarcomas were in patients whose symptoms had ranged in duration from months to many years before medical treatment had been sought. One patient had a nine-year history of pain in the ankle and a diagnosis based on a biopsy that was performed during arthroscopy of the joint. It is not unusual for a synovial sarcoma to remain relatively quiescent for a long period of time. Anderson and Wildermuth found an average duration of symptoms of thirty-five months in their patients, one of whom had had symptoms for thirty years before seeking treatment. Therefore, malignancy should not be ruled out on the basis of chronicity.

It is of interest that all seven epidermal inclusion cysts and sixteen of the twenty-four ganglion cysts were in women. Also, six of the eleven patients who had a planter...
fibromatoses were women. Stoyle commented on the rarity of this lesion in women, but Allen et al. reported that twenty-six of their sixty-nine patients were women.

The benign lesions were fairly normally distributed with respect to age, most having occurred in patients between the ages of twenty and sixty years. In contrast, no sarcomas were seen in the sixth decade of life; they occurred instead in the younger and older age-groups. This is due to the high frequency of synovial sarcoma in younger people, with a peak incidence between the second and fifth decades, and to the increased incidence of sarcoma in general after the age of fifty-five years. There were too few sarcomas to permit any conclusions related to the patient's age, but their distribution was in agreement with that reported by Simon and Enneking.

Analysis of the lesions by site revealed that most of the malignant tumors, especially the synovial sarcomas, had a predilection for the ankle, heel, or dorsum of the foot; the sole of the foot was rarely involved. In contrast, 90 per cent of all lesions in the sole in patients between the ages of thirty and seventy years were plantar fibromatoses. This is in agreement with the study of Allen et al., who found that sixty-nine of seventy-eight lesions in the sole of the foot were plantar fibromatoses, although eight of the remaining nine were synovial sarcomas. Ganglion cysts also tended to show a preference by site, accounting for 32 per cent of the lesions about the ankle and 48 per cent of those in the dorsum of the foot.

The relatively large number of synovial sarcomas (five), which accounted for 45 per cent of the malignant tumors in our series, was surprising. To test the significance of this finding, an analysis was performed using the theorem of Bayes. According to Bayes' rule, the probability of a sarcoma in the foot being of a given tissue-type equals the frequency of that type of tumor among all sarcomas, multiplied by the probability of finding that tumor in the foot, and divided by the frequency of sarcomas arising in the foot. To obtain an estimate of the distribution of sarcomas by type, the results of four recent large series of soft-tissue sarcomas were combined. The probability of finding each type of tumor in the foot or ankle was calculated on the basis of earlier reports (Table IV). No true value for the proportion of all sarcomas arising in the foot was found, but an estimate of approximately 4 per cent was made on the basis of the statement by Russell et al. that 8 per cent of soft-tissue sarcomas arise distal to the knee. The resulting distribution of soft-tissue sarcomas in the foot was then calculated. When this method was used, synovial sarcomas were found to account for 56 per cent of sarcomas in the foot, a figure that is in reasonably good agreement with our incidence of 45 per cent. The remaining malignant tumors had an incidence of 10 per cent or less. While the figures that were used to arrive at this conclusion were not exact, the relative frequency of sarcomas indicates that synovial sarcoma should be the most frequently encountered malignant soft-tissue tumor in the foot and ankle.

Radiographic abnormalities can sometimes be useful in formulating a differential diagnosis of a soft-tissue lesion in the foot or ankle. In our series, twenty-four (35 per cent) of the sixty-nine patients whose radiographs we reviewed had a visible soft-tissue mass, and eight (12 per cent) had other abnormalities. Table V lists the radiographic findings that have been documented in the literature. The most diagnostic of these findings is the presence of an abnormal fat density associated with lipoma. The presence of a tumor containing mixed areas of fat and soft-tissue densities should alert the physician to the possibility of liposarcoma. Several types of tumors, both benign and malignant, may exhibit either abnormal calcification or secondary erosion or destruction of bone. The presence of a subchondral cyst should signal the possibility of pigmented villonodular synovitis. Scalloping of the terminal phalanx of a toe is characteristic of a glomus tumor or an epidermal inclusion cyst. Most importantly, extensive calcification of a lesion, associated with secondary destruction of the surrounding bone, should suggest a diagnosis of synovial sarcoma. While calcification was notably absent in our five patients who had a synovial sarcoma, it has been reported in as many as 40 per cent of patients, and it may be so exuberant that it mimics osteogenic sarcoma.

References