# Benign Soft-Tissue Tumors in a Large Referral Population:
## Distribution of Specific Diagnoses by Age, Sex, and Location

Mark J. Kransdorf[1]

**OBJECTIVE. The purpose of this study was to determine the specific diagnoses, relative prevalence, and the age, sex, and skeletal distribution of benign soft-tissue tumors and to ascertain the relative frequency of these tumors in specific anatomic locations and age groups among a population of patients in a large pathologic consultation service.**

**MATERIALS AND METHODS. The computer diagnoses of 39,179 lesions occurring in 38,484 patients seen by the Armed Forces Institute of Pathology soft-tissue pathologists during the 10-year period starting January 1, 1980, and ending December 31, 1989, were retrospectively reviewed. All lesions were placed in one of 121 major categories in accordance with the classification system used by the World Health Organization and coded to one of 32 anatomic locations such as hand, wrist, and forearm. Age and sex of the patients were also recorded. For purposes of analysis, all lesions were placed in one of 10 categories: hand and wrist, upper extremity, proximal limb girdle (axilla and shoulder), foot and ankle, lower extremity, hip and buttocks region, head and neck, trunk, retroperitoneum, and other lesions. The study group included 31,047 mesenchymal lesions, of which 18,677 were benign.**

**RESULTS. Approximately two thirds of soft-tissue tumors were classified into seven diagnostic categories: lipoma and lipoma variants (16%), fibrous histiocytoma (13%), nodular fasciitis (11%), hemangioma (8%), fibromatosis (7%), neurofibroma (5%), and schwannoma (5%). Approximately 80% of all benign tumors were placed in seven diagnostic categories for each age and location. In the retroperitoneum, for example, approximately half the benign lesions in the 16- to 25-year old group were fibromatosis (20%), schwannoma (14%), and neurofibroma (13%). For the same location in children 5 years old or younger, almost two thirds of the benign tumors were lipoblastoma (37%) or lymphangioma (26%).**

**CONCLUSION. Despite the large number of pathologic possibilities, most benign soft-tissue tumors are classified into a small number of specific diagnostic categories. These may be further defined when the location of the lesion and the age of the patient are considered. Knowledge of tumor prevalence will assist the radiologist in establishing a suitably ordered differential diagnosis when a soft-tissue tumor has a nonspecific radiologic appearance.**

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The imaging evaluation of soft-tissue tumors has undergone a dramatic evolution with the advent of CT and MR imaging. Despite these sophisticated technologies and the increasing number of lesions that may have a characteristic imaging appearance, the vast majority of lesions remain nonspecific, with a correct histologic diagnosis reached on the basis of imaging studies in only approximately one quarter of cases [1–3].

Unlike with their intraosseous counterparts, it is often not possible to establish a meaningful differential diagnosis for these nonspecific lesions or to reliably determine if they are benign or malignant. In these cases, knowledge of the tumor's prevalence, along with the patient's age and the lesion's location, will allow a suitably ordered differential diagnosis. The purpose of this study was to determine the relative prevalence and the age, sex, and skeletal distribution of benign soft-tissue tumors and to ascertain the relative frequency of these tumors in specific anatomic

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[1]Department of Radiology, Saint Mary's Hospital, Richmond, VA 23226 and Department of Radiologic Pathology, Armed Forces Institute of Pathology, Washington, DC 20306-6000. Address correspondence to M. J. Kransdorf at Saint Mary's Hospital.

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locations and age groups among a population of patients in a large pathologic consultation service.

## Materials and Methods

The computer records of all patients seen in consultation by the Department of Soft-Tissue Pathology, Armed Forces Institute of Pathology, during the 10-year period starting January 1, 1980, and ending December 31, 1989, were reviewed retrospectively. Only mesenchymal lesions originating in soft tissue were included in the study. Intraabdominal and retroperitoneal lesions were also included when the lesions were not thought to originate in bowel or abdominal viscera. Hence, an extrarenal angiomyolipoma was included, whereas a lymphangioma of the spleen was not. Lesions arising in the chest and abdominal walls and paraspinal region were also included, as they are frequently within the purview of the musculoskeletal radiologist.

Computer diagnoses were accessed under the Pathology Natural Language Retrieval System (PANLARS) and were individually reviewed and standardized in accordance with the classification system used by the World Health Organization [4] (as modified by Enzinger and Weiss [5]). No attempt was made to reclassify computer diagnoses, and histologic material was not reexamined. A lesion diagnosed as a "lipoma with areas of hibernomatous change" was coded as such and not as a "hibernoma." Lesions were subcategorized when possible and when such information was clinically relevant. All soft-tissue tumors and tumorlike lesions were placed in one of 121 major diagnostic categories. Lesions were coded to 32 anatomic locations such as hand, wrist, forearm, arm, and so on. For purposes of analysis, all lesions were placed in one of 10 categories: hand and wrist, upper extremity, proximal limb girdle (axilla and shoulder), foot and ankle, lower extremity, hip and buttocks region, head and neck, trunk, retroperitoneum, and other lesions. This last category included lesions coded as abdomen, pelvis, mediastinum, or location unknown.

Age was recorded to the nearest year for all patients more than 1 year old. Patients less than 1 year old were grouped into newborn (1 day or less), 1–10 days, 11–28 days, 29 days through 2 months, 3–5 months, and 6–11 months of age. In addition, the patient's sex and race were recorded for each case. In total, the records of 42,490 lesions occurring in 38,484 patients were reviewed. Multiple lesions were seen in 639 patients (2%), including 592 patients with two lesions, 39 patients with three lesions, seven patients with four lesions, and one patient with five lesions. Sequential biopsy specimens were found in 3311 cases. This often involved an initial incisional biopsy specimen and subsequent material from definitive surgery. Such cases were counted only once, so as not to falsely increase the number of a particular lesion. A total of 39,179 soft-tissue tumors (and tumorlike masses) were available for detailed analysis. From this group, 8132 nonmesenchymal lesions were excluded. This represented approximately 21% of all lesions and consisted of 3370 malignant and 4762 benign lesions: 1487 cases of carcinoma; 564 cases of malignant melanoma; 472 cases of lymphoma; 75 other malignant tumors (e.g., seminoma, plasmacytoma, germ cell tumor, and malignant teratoma); 772 malignant tumors that could not be further classified; 2932 proliferative, reactive, and inflammatory lesions; 543 nonmesenchymal benign lesions (e.g., teratoma, hamartoma, histiocytosis, pilomatrixoma, and syringoma); 160 benign lesions that could not be further classified; and 1127 miscellaneous lesions (e.g., fat necrosis, foreign body reaction, hematoma, lipogranuloma, and thrombus).

The study group consisted of 31,047 lesions: 12,370 malignant and 18,677 benign. Borderline and low-grade malignant lesions, such as dermatofibrosarcoma protuberans, atypical fibroxanthoma, angiomatoid malignant fibrous histiocytoma, infantile fibrosarcoma, and so on, were classified as malignant tumors. Superficial and deep (musculoaponeurotic) fibromatosis were considered benign lesions. A total of 30,597 patients were in the study group: 16,727 men, 13,611 women, and 259 whose sex was unknown. The patient's age was known in 30,244 cases and ranged from newborn to 97 years.

In 26,854 cases (10,184 malignant and 16,670 benign), the patient's age was known and the lesion was located in one of the anatomic categories listed above (hand and wrist, upper extremity, etc.), excluding "other" lesions. The seven most frequent malignant lesions were then identified for each of the nine anatomic areas for ages 0–5 years, 6–15 years, 16–25 years, 26–45 years, 46–65 years, and for patients more than 65 years old.

## Results

There were 18,677 benign mesenchymal lesions. Approximately 70% of benign lesions were classified into eight pathologic diagnostic categories: lipoma and lipoma variants (16%), fibrous histiocytoma (13%), nodular fasciitis (11%), hemangioma (8%), fibromatosis (7%), neurofibroma (5%), schwannoma (5%), and giant cell tumor of the tendon sheath (4%). A summary of the benign lesions is given in Table 1, including patients' age distribution and mean age, sex, and skeletal distribution of lesions for all histologic diagnoses.

The number and percentage of the most common benign lesions for each age and location are shown in Table 2. All hemangiomas have been grouped together for this analysis, as have lymphangiomas, and superficial and deep fibromatoses. Lipoma, lipomatosis, spindle cell lipoma, pleomorphic lipoma, and intramuscular lipoma have been combined and classified as lipoma. In total, 52 diagnostic categories were used for this analysis. Approximately 80% of all benign tumors can be placed in the seven most common diagnostic categories for each age and location.

## Discussion

Radiologic detection and evaluation of soft-tissue masses have become increasingly important with the advent of CT and MR imaging. Unfortunately, with the exception of a minority of lesions (e.g., lipoma, hemangioma, subacute hematoma, pigmented villonodular synovitis), the radiologic appearance of most soft-tissue masses remains nonspecific [6]. Consequently, an appropriately ordered differential diagnosis based on a lesion's radiologic appearance is difficult, if not impossible. This difficulty is compounded by the seemingly endless list of diagnostic possibilities presented in the literature. In an attempt to provide a framework from which to approach this problem, a retrospective review of all soft-tissue lesions seen by our soft-tissue pathology department was undertaken to determine the prevalence and distribution of each lesion, as well as the tumor distribution for specific age groups and locations. To my knowledge, an analysis of this type and scope has not been previously reported.

A number of difficulties are inherent in a review of this nature. The large number of patients and the extended period over which they were seen in consultation make it virtually impossible for a single pathologist to assume responsibility for all histologic diagnoses or to review the histologic material for the entire study group. All material was, however, reviewed by a staff pathologist in the Department of Soft-Tissue Pathology, Armed Forces Institute of Pathology, who has expertise in the evaluation of soft-tissue tumors. No histologic material was reviewed for this study, and diagnoses are as coded by the original pathologist. No attempt was made to reclassify lesions or to change diagnoses.

**TABLE 1: Distribution of Diagnoses of 18,677 Benign Soft-Tissue Tumors by Age, Sex, and Anatomic Location**

| Diagnosis | Total No. (%) | Age Mean/SD (80% Range) | Sex M/F/Unknown | Hand Wrist | Upper Extremity | Proximal Limb | Foot Ankle | Lower Extremity | Hip Buttock | Head Neck | Trunk | Retro-perito-neum | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lipoma and lipoma variants | 2999 (16.1) | | | | | | | | | | | | |
| Lipoma | 1453 | 48/17 (26–68) | 960/484/9 | 89 | 102 | 189 | 62 | 233 | 132 | 252 | 332 | 19 | 43 |
| Spindel cell lipoma | 816 | 56/14 (37–74) | 714/98/4 | 24 | 17 | 150 | 7 | 21 | 32 | 331 | 223 | 1 | 10 |
| Intramuscular lipoma | 253 | 52/18 (26–73) | 143/108/2 | 1 | 26 | 31 | 2 | 113 | 8 | 22 | 44 | 2 | 4 |
| Angiolipoma | 235 | 41/16 (22–64) | 180/50/5 | 4 | 104 | 4 | 3 | 28 | 2 | 4 | 76 | 1 | 9 |
| Pleomorphic lipoma | 207 | 57/14 (36–74) | 143/61/3 | 9 | 25 | 36 | 4 | 7 | 1 | 83 | 40 | 0 | 2 |
| Perineural fibrolipoma | 25 | 24/15 (9–41) | 14/11/0 | 14 | 4 | 0 | 4 | 3 | 0 | 0 | 0 | 0 | 0 |
| Lipomatosis | 10 | 30/23 (2–53) | 3/7/0 | 0 | 0 | 1 | 3 | 2 | 0 | 0 | 0 | 0 | 0 |
| Fibrous histiocytoma[a] | 2385 (12.8) | 33/17 (13–57) | 1283/1078/24 | 354 | 340 | 234 | 178 | 561 | 88 | 300 | 283 | 0 | 47 |
| Nodular fasciitis | 2116 (11.3) | 31/16 (11–51) | 1136/967/13 | 152 | 612 | 130 | 13 | 288 | 80 | 418 | 391 | 0 | 32 |
| Hemangioma (all) | 1418 (7.6) | | | | | | | | | | | | |
| Hemangioma, not further classified | 396 | 32/21 (7–62) | 183/211/2 | 81 | 42 | 12 | 40 | 59 | 21 | 59 | 65 | 6 | 11 |
| Capillary hemangioma | 347 | 34/23 (1–65) | 168/175/4 | 121 | 28 | 10 | 20 | 22 | 4 | 103 | 31 | 2 | 6 |
| Intramuscular hemangioma | 301 | 29/17 (9–51) | 161/140/0 | 10 | 44 | 21 | 9 | 76 | 9 | 30 | 88 | 6 | 8 |
| Cavernous hemangioma | 138 | 25/23 (<1–60) | 66/70/2 | 21 | 14 | 9 | 8 | 24 | 3 | 22 | 33 | 2 | 2 |
| Epithelioid hemangioma | 131 | 38/15 (21–59) | 83/45/3 | 16 | 12 | 3 | 5 | 2 | 5 | 71 | 11 | 2 | 4 |
| Arteriovenous hemangioma | 66 | 24/19 (3–49) | 37/29/0 | 14 | 8 | 1 | 6 | 13 | 2 | 9 | 7 | 5 | 1 |
| Angiomatosis | 39 | 20/18 (2–49) | 16/22/1 | 3 | 2 | 0 | 12 | 13 | 1 | 1 | 6 | 1 | 0 |
| Fibromatosis (all) | 1297 (6.9) | | | | | | | | | | | | |
| Superficial | 295 | 41/18 (17–65) | 199/94/2 | 76 | 0 | 0 | 218 | 0 | 0 | 0 | 1 | 0 | 0 |
| Deep | 1002 | 34/18 (13–60) | 412/585/5 | 70 | 69 | 69 | 82 | 103 | 70 | 72 | 327 | 76 | 64 |
| Neurofibroma | 973 (5.3) | 37/19 (16–66) | 529/439/5 | 92 | 106 | 37 | 58 | 176 | 86 | 178 | 171 | 30 | 39 |
| Schwannoma | 895 (5.2) | 46/19 (22–72) | 504/387/4 | 77 | 107 | 39 | 81 | 157 | 52 | 97 | 120 | 102 | 63 |
| Giant cell tumor tendon sheath | 731 (3.9) | 39/18 (18–64) | 384/339/8 | 474 | 23 | 1 | 113 | 90 | 4 | 0 | 4 | 0 | 22 |
| Myxoma[b] | 597 (3.2) | 52/16 (24–74) | 286/306/5 | 39 | 74 | 45 | 24 | 219 | 84 | 49 | 53 | 1 | 9 |
| Fibroma (all) | 489 (2.6) | | | | | | | | | | | | |
| Fibroma of tendon sheath | 272 | 35/16 (15–75) | 174/97/1 | 228 | 5 | 0 | 22 | 9 | 0 | 1 | 1 | 0 | 6 |
| Fibroma | 193 | 40/21 (11–67) | 113/78/2 | 39 | 12 | 11 | 22 | 32 | 17 | 30 | 25 | 0 | 5 |
| Nuchal fibroma | 24 | 46/15 (22–62) | 18/6/0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 9 | 0 | 0 |
| Granuloma annulare[c] | 408 (2.2) | 23/21 (2–58) | 186/218/4 | 79 | 89 | 0 | 110 | 79 | 9 | 31 | 2 | 0 | 9 |
| Hemangiopericytoma | 384 (2.1) | 44/19 (23–70) | 159/225/0 | 11 | 24 | 19 | 10 | 59 | 57 | 73 | 59 | 69 | 3 |
| Granular cell tumor | 348 (1.9) | 35/16 (15–56) | 143/204/1 | 37 | 47 | 29 | 12 | 51 | 31 | 34 | 97 | 2 | 8 |
| Leiomyoma (all) | 311 (1.7) | | | | | | | | | | | | |
| Angiomyoma (vascular leiomyoma) | 185 | 51/17 (30–73) | 125/60/0 | 32 | 24 | 2 | 58 | 55 | 3 | 7 | 1 | 0 | 3 |
| Leiomyoma | 126 | 40/20 (14–67) | 41/85/0 | 3 | 9 | 3 | 19 | 17 | 27 | 8 | 9 | 13 | 18 |
| Chondroma[d] | 277 (1.5) | 44/20 (16–70) | 149/125/3 | 150 | 8 | 2 | 76 | 17 | 3 | 6 | 11 | 1 | 3 |
| Myofibromatosis | 178 (1.0) | 14/20 (<1–52) | 106/68/4 | 18 | 13 | 13 | 0 | 27 | 9 | 63 | 30 | 1 | 4 |
| Glomus tumor[e] | 164 (0.9) | 47/20 (19–71) | 107/55/2 | 52 | 38 | 3 | 12 | 38 | 7 | 4 | 7 | 1 | 2 |
| Pigmented villonodular synovitis[f] | 161 (0.9) | 38/17 (18–59) | 93/67/1 | 22 | 1 | 1 | 52 | 72 | 5 | 1 | 2 | 0 | 5 |
| Lymphangioma (all) | 160 (0.9) | | | | | | | | | | | | |
| Lymphangioma | 151 | 19/20 (1–50) | 67/84/0 | 12 | 14 | 15 | 5 | 21 | 9 | 21 | 19 | 32 | 3 |
| Lymphangiomatosis | 9 | 28/27 (4–60) | 3/6/0 | 0 | 2 | 1 | 1 | 2 | 0 | 1 | 1 | 0 | 1 |
| Ganglion | 159 (0.9) | 40/18 (19–65) | 88/70/1 | 84 | 6 | 3 | 17 | 36 | 7 | 2 | 1 | 0 | 3 |
| Proliferative fasciitis | 144 (0.8) | 54/17 (33–71) | 82/62/0 | 3 | 39 | 9 | 5 | 53 | 3 | 5 | 27 | 0 | 0 |

**TABLE 1: Distribution of Diagnoses of 18,677 Benign Soft-Tissue Tumors by Age, Sex, and Anatomic Location (continued)**

| Diagnosis | Total No. (%) | Age Mean/SD (80% Range) | Sex M/F/Unknown | Hand Wrist | Upper Extremity | Proximal Limb | Foot Ankle | Lower Extremity | Hip Buttock | Head Neck | Trunk | Retro-perito-neum | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Myositis ossificans (all) | 139 (0.7) | | | | | | | | | | | | |
| Myositis ossificans | 78 | 35/20 (13–64) | 42/36/0 | 8 | 9 | 10 | 0 | 27 | 8 | 3 | 12 | 1 | 0 |
| Panniculitis ossificans | 46 | 32/15 (16–54) | 21/25/0 | 9 | 0 | 0 | 1 | 19 | 3 | 2 | 11 | 0 | 1 |
| Fibroosseous pseudotumor | 12 | 32/19 (7–62) | 4/8/0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fibrodysplasia oss progressiva[g] | 3 | 6/4 (2–10) | 2/1/0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| Papillary endothelial hyperplasia | 136 (0.7) | 41/20 (18–70) | 70/64/2 | 42 | 12 | 12 | 12 | 8 | 2 | 29 | 15 | 2 | 2 |
| Infantile fibromatosis[h] | 116 (0.6) | 3/5 (<1–8) | 69/44/3 | 25 | 14 | 4 | 21 | 10 | 6 | 19 | 17 | 0 | 0 |
| Lipoblastoma (all) | 114 (0.6) | | | | | | | | | | | | |
| Lipoblastoma | 88 | 4/4 (1–10) | 52/33/3 | 3 | 5 | 8 | 10 | 11 | 13 | 10 | 17 | 5 | 6 |
| Lipoblastomatosis | 26 | 3/4 (1–5) | 11/14/1 | 0 | 0 | 5 | 0 | 4 | 5 | 2 | 7 | 3 | 0 |
| Neurothekeoma | 92 (0.5) | 26/16 (9–48) | 33/59/0 | 10 | 15 | 6 | 6 | 22 | 2 | 16 | 12 | 0 | 3 |
| Fibrous hamartoma of infancy | 84 (0.4) | 1/3 (<1–2) | 52/29/3 | 1 | 15 | 23 | 0 | 9 | 14 | 5 | 15 | 1 | 1 |
| Neuroma | 76 (0.4) | 38/19 (17–67) | 43/32/1 | 16 | 5 | 0 | 31 | 6 | 1 | 13 | 1 | 0 | 3 |
| Calcifying aponeurotic fibroma | 75 (0.4) | 16/12 (6–30) | 48/27/0 | 43 | 3 | 1 | 12 | 7 | 0 | 1 | 8 | 0 | 0 |
| Mesothelioma | 72 (0.4) | 50/18 (26–74) | 32/40/0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 18 | 42 |
| Juvenile xanthogranuloma | 71 (0.4) | 4/9 (<1–14) | 43/27/1 | 0 | 7 | 3 | 2 | 11 | 2 | 16 | 25 | 1 | 4 |
| Proliferative myositis | 57 (0.3) | 58/17 (45–78) | 26/31/0 | 0 | 9 | 7 | 0 | 11 | 1 | 12 | 16 | 0 | 1 |
| Paraganglioma | 56 (0.3) | 47/19 (24–70) | 24/31/1 | 0 | 0 | 0 | 0 | 1 | 2 | 24 | 0 | 22 | 7 |
| Tumoral calcinosis | 55 (0.3) | 48/24 (12–74) | 18/35/2 | 17 | 9 | 4 | 3 | 6 | 9 | 1 | 3 | 1 | 2 |
| Elastofibroma | 51 (0.3) | 61/11 (48–74) | 27/24/0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 49 | 0 | 0 |
| (Teno)synovial chondromatosis | 46 (0.3) | 44/17 (25–65) | 29/17/0 | 23 | 1 | 2 | 7 | 11 | 0 | 1 | 1 | 0 | 0 |
| Sclerosing retroperitonitis[i] | 44 (0.2) | 52/15 (31–65) | 30/13/1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 3 |
| Hibernoma | 41 (0.2) | 32/14 (21–50) | 20/21/0 | 0 | 2 | 4 | 0 | 9 | 4 | 5 | 15 | 2 | 0 |
| Ganglioneuroma | 37 (0.2) | 22/15 (4–44) | 17/20/0 | 0 | 0 | 1 | 0 | 0 | 2 | 4 | 7 | 18 | 5 |
| Other | 144 (0.8) | | | | | | | | | | | | |
| Mesenchymal lesion, not further classified | 577 (3.1) | | | | | | | | | | | | |

[a] Includes dermatofibroma.

[b] Includes intramuscular myxoma and juxtaarticular myxoma.

[c] Includes necrobiotic nodule.

[d] Includes osteochondroma and a single osteoma.

[e] Includes glomangioma and glomangiomyoma.

[f] Includes diffuse giant cell tumor of tendon sheath.

[g] Fibrodysplasia ossificans progressiva.

[h] Includes 19 cases of digital fibromatosis (11 hand and eight foot) and two cases of fibromatosis coli.

[i] Includes sclerosing mediastinitis.

**TABLE 2: Distribution of Common Benign Soft-Tumors by Anatomic Location and Age**

| Age (yrs) | Hand and Wrist | No. (%) | Upper Extremity | No. (%) | Axilla and Shoulder | No. (%) | Foot and Ankle | No. (%) | Lower Extremity | No. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fibromatosis | 21 (22) | Fibrous histiocytoma | 6 (6) | Myofibromatosis | 6 (8) | Infantile digital fibromatosis | 7 (9) | Lipoblastoma | 13 (7) |
| 0–5 | Hemangioma | 15 (15) | Fibrous hamartoma of infancy | 15 (16) | Fibrous hamartoma of infancy | 23 (29) | Granuloma annulare | 23 (30) | Granuloma annulare | 42 (23) |
| | Granuloma annulare | 14 (14) | Granuloma annulare | 15 (16) | Hemangioma | 12 (15) | Fibromatosis | 19 (25) | Hemangioma | 26 (14) |
| | | | Hemangioma | 14 (15) | Lipoblastoma | 11 (14) | Hemangioma | 8 (11) | Myofibromatosis | 16 (9) |
| | Infantile digital fibromatosis | 8 (8) | Fibromatosis | 13 (14) | Fibrous histiocytoma | 7 (9) | | | Fibrous histiocytoma | 15 (8) |
| | Aponeurotic fibroma | 7 (7) | Juvenile xanthogranuloma | 6 (6) | Lymphangioma | 5 (6) | Lipoblastoma | 6 (8) | Lymphangioma | 10 (6) |
| | Fibrous histiocytoma | 5 (5) | Myofibromatosis | 6 (6) | Nodular fasciitis | 4 (5) | Lipoma | 4 (5) | Juvenile xanthogranuloma | 10 (6) |
| | Nodular fasciitis | 5 (5) | | | | | Neurofibroma | 3 (4) | | |
| | Other | 22 (23) | Other | 19 (20) | Other | 12 (15) | Other | 6 (8) | Other | 48 (27) |
| 6–15 | Fibrous histiocytoma | 32 (14) | Fibrous histiocytoma | 41 (23) | Fibrous histiocytoma | 25 (34) | Fibromatosis | 37 (23) | Hemangioma | 47 (22) |
| | Hemangioma | 31 (13) | Nodular fasciitis | 39 (21) | Nodular faciitis | 18 (25) | Granuloma annulare | 21 (13) | Fibrous histiocytoma | 34 (16) |
| | Aponeurotic fibroma | 25 (11) | Hemangioma | 24 (13) | Hemangioma | 7 (10) | Hemangioma | 21 (13) | Nodular fasciitis | 22 (10) |
| | Fibroma of tendon sheath | 22 (9) | Granuloma annulare | 12 (7) | Granular cell tumor | 4 (5) | Fibrous histiocytoma | 14 (9) | Granuloma annulare | 20 (9) |
| | GCTTS[b] | 17 (7) | Fibromatosis | 12 (7) | Neurofibroma | 3 (4) | GCTTS | 13 (8) | Fibromatosis | 15 (7) |
| | Fibromatosis | 14 (6) | Neurofibroma | 7 (4) | Lymphangioma | 2 (3) | Chondroma | 11 (7) | Lipoma | 13 (6) |
| | Lipoma | 9 (4) | Neurothekeoma | 6 (3) | Myofibromatosis | 2 (3) | Lipoma | 9 (6) | Neurofibroma | 8 (4) |
| | Other | 85 (36) | Other | 41 (23) | Other | 12 (16) | Other | 35 (22) | Other | 57 (26) |
| 16–25 | GCTTS | 84 (20) | Nodular fasciitis | 130 (35) | Fibrous histiocytoma | 62 (36) | Fibromatosis | 46 (22) | Fibrous histiocytoma | 118 (24) |
| | Fibrous histiocytoma | 57 (14) | Fibrous histiocytoma | 87 (23) | Nodular fasciitis | 35 (20) | GCTTS | 29 (14) | Nodular fasciitis | 61 (13) |
| | Hemangioma | 40 (10) | Hemangioma | 36 (10) | Fibromatosis | 16 (9) | Granuloma annulare | 25 (12) | Hemangioma | 55 (11) |
| | Fibroma of tendon sheath | 40 (10) | Neurofibroma | 24 (6) | Lipoma | 14 (8) | Fibrous histiocytoma | 24 (12) | Neurofibroma | 48 (10) |
| | Nodular fasciitis | 26 (6) | Granuloma annulare | 20 (5) | Neurofibroma | 12 (7) | Hemangioma | 13 (6) | Fibromatosis | 38 (8) |
| | Granuloma annulare | 21 (5) | Granular cell tumor | 17 (5) | Hemangioma | 4 (2) | PVNS[c] | 12 (6) | Lipoma | 22 (5) |
| | Ganglion | 20 (5) | Schwannoma | 11 (3) | Schwannoma | 4 (2) | Neurofibroma | 11 (5) | Schwannoma | 20 (4) |
| | Other | 132 (31) | Other | 51 (14) | Other | 25 (15) | Other | 45 (22) | Other | 122 (25) |
| 26–45 | Fibrous histiocytoma | 167 (18) | Nodular fasciitis | 309 (38) | Lipoma | 105 (28) | Fibromatosis | 99 (21) | Fibrous histiocytoma | 245 (25) |
| | GCTTS | 148 (16) | Fibrous histiocytoma | 145 (18) | Fibrous histiocytoma | 92 (24) | Fibrous histiocytoma | 74 (16) | Nodular fasciitis | 229 (23) |
| | Fibroma of tendon sheath | 106 (11) | Angiolipoma | 48 (6) | Nodular fasciitis | 55 (14) | GCTTS | 41 (9) | Lipoma | 101 (10) |
| | Hemangioma | 86 (10) | Hemangioma | 43 (5) | Fibromatosis | 29 (8) | Hemangioma | 36 (8) | Neurofibroma | 71 (7) |
| | Nodular fasciitis | 79 (8) | Schwannoma | 43 (5) | Hemangioma | 17 (4) | Schwannoma | 30 (6) | Schwannoma | 59 (6) |
| | Fibromatosis | 46 (5) | Neurofibroma | 37 (5) | Neurofibroma | 13 (3) | Neurofibroma | 24 (5) | Myxoma | 53 (5) |
| | Chondroma | 42 (4) | Lipoma | 32 (4) | Schwannoma | 12 (3) | Chondroma | 23 (5) | Hemangioma | 52 (5) |
| | Other | 269 (29) | Other | 153 (19) | Other | 57 (15) | Other | 135 (29) | Other | 185 (19) |
| 46–65 | GCTTS | 143 (23) | Nodular fasciitis | 86 (20) | Lipoma | 189 (58) | Fibromatosis | 83 (25) | Lipoma | 157 (23) |
| | Fibrous histiocytoma | 63 (10) | Lipoma | 80 (19) | Fibrous histiocytoma | 28 (19) | Fibrous histiocytoma | 43 (13) | Myxoma | 109 (16) |
| | Hemangioma | 61 (10) | Fibrous histiocytoma | 44 (10) | Myxoma | 16 (5) | Lipoma | 35 (11) | Fibrous histiocytoma | 93 (14) |
| | Lipoma | 59 (9) | Schwannoma | 30 (7) | Fibromatosis | 14 (4) | Schwannoma | 25 (8) | Nodular fasciitis | 40 (6) |
| | Chondroma | 52 (8) | Neurofibroma | 24 (6) | Nodular fasciitis | 13 (4) | GCTTS | 21 (6) | Schwannoma | 39 (6) |
| | Fibromatosis | 43 (7) | Myxoma | 24 (6) | Schwannoma | 12 (4) | Chondroma | 21 (6) | Neurofibroma | 31 (5) |
| | Fibroma of tendon sheath | 37 (6) | Hemangioma | 19 (4) | Granular cell tumor | 12 (4) | Hemangioma | 16 (5) | Proliferative fasciitis | 28 (4) |
| | Other | 172 (27) | Other | 125 (29) | Other | 44 (13) | Other | 89 (27) | Other | 186 (27) |

**TABLE 2: Distribution of Common Benign Soft-Tumors by Anatomic Location and Age (continued)**

| Age (yrs) | Hand and Wrist | No. (%) | Upper Extremity | No. (%) | Axilla and Shoulder | No. (%) | Foot and Ankle | No. (%) | Lower Extremity | No. (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 66 and over | GCTTS | 51 (21) | Lipoma | 39 (22) | Lipoma | 83 (58) | Fibromatosis | 16 (14) | Lipoma | 68 (26) |
| | Hemangioma | 24 (10) | Myxoma | 19 (11) | Myxoma | 14 (10) | Schwannoma | 15 (13) | Myxoma | 44 (17) |
| | Schwannoma | 24 (10) | Nodular fasciitis | 18 (10) | Schwannoma | 6 (4) | Fibrous histiocytoma | 13 (11) | Fibrous histiocytoma | 33 (13) |
| | Chondroma | 24 (10) | Schwannoma | 17 (9) | Fibromatosis | 5 (3) | Chondroma | 11 (9) | Schwannoma | 31 (12) |
| | Neurofibroma | 21 (9) | Glomus tumor | 12 (7) | Fibrous histiocytoma | 5 (3) | Lipoma | 10 (8) | Hemangiopericytoma | 10 (4) |
| | Fibromatosis | 14 (6) | Neurofibroma | 10 (6) | Proliferative fasciitis | 5 (3) | Granuloma annulare | 8 (7) | Neurofibroma | 9 (4) |
| | Lipoma | 13 (5) | Angiolipoma | 10 (6) | Hemangioma | 4 (3) | GCTTS | 6 (5) | Hemangioma | 8 (3) |
| | Other | 71 (29) | Other | 55 (31) | Other | 22 (15) | Other | 39 (33) | Other | 56 (22) |

| Age (yrs) | Hip, Groin, & Buttocks | No. (%) | Head and Neck | No. (%) | Trunk | No. (%) | Retroperitoneum | No. (%) |
|---|---|---|---|---|---|---|---|---|
| 0–5 | Fibrous hamartoma of infancy | 14 (20) | Nodular fasciitis | 47 (20) | Hemangioma | 36 (18) | Lipoblastoma | 7 (37) |
| | Lipoblastoma | 14 (20) | Hemangioma | 43 (18) | Juvenile xanthogranuloma | 24 (12) | Lymphangioma | 5 (26) |
| | Myofibromatosis | 8 (11) | Myofibromatosis | 27 (11) | Myofibromatosis | 24 (12) | Hemangioma | 4 (21) |
| | Lymphangioma | 7 (10) | Fibromatosis | 30 (13) | Nodular fasciitis | 17 (8) | Ganglioneuroma | 2 (11) |
| | Fibrous histiocytoma | 5 (7) | Granuloma annulare | 14 (6) | Lipoblastoma | 17 (8) | Fibrous hamartoma of infancy | 1 (5) |
| | Nodular fasciitis | 4 (6) | Fibrous histiocytoma | 13 (5) | Fibromatosis | 23 (11) | | |
| | Fibromatosis | 4 (6) | Lipoblastoma | 11 (5) | Fibrous hamartoma of infancy | 15 (7) | | |
| | Other | 14 (20) | Other | 52 (22) | Other | 55 (27) | | |
| 6–15 | Nodular fasciitis | 15 (27) | Nodular fasciitis | 75 (33) | Nodular fasciitis | 54 (28) | Lymphangioma | 7 (37) |
| | Fibroma | 7 (13) | Fibrous histiocytoma | 34 (15) | Fibrous histiocytoma | 43 (22) | Ganglioneuroma | 4 (21) |
| | Fibrous hystiocytoma | 6 (11) | Neurofibroma | 23 (10) | Hemangioma | 25 (13) | Schwannoma | 2 (11) |
| | Fibromatosis | 6 (11) | Hemangioma | 21 (9) | Lipoma | 9 (5) | Fibromatosis | 2 (11) |
| | Lipoma | 5 (9) | Myofibromatosis | 14 (6) | Neurofibroma | 7 (4) | Paraganglioma | 1 (5) |
| | Lipoblastoma | 3 (5) | Fibromatosis | 15 (7) | Fibromatosis | 8 (4) | Hemangioma | 1 (5) |
| | Neurofibroma | 3 (5) | Lipoma | 6 (3) | Granular cell tumor | 6 (3) | Inflammatory pseudotumor | 1 (5) |
| | Other | 10 (18) | Other | 40 (18) | Other | 43 (22) | Other | 1 (5) |
| 16–25 | Neurofibroma | 20 (16) | Nodular fasciitis | 61 (21) | Nodular fasciitis | 112 (24) | Fibromatosis | 14 (20) |
| | Fibromatosis | 18 (15) | Hemangioma | 48 (17) | Fibromatosis | 72 (16) | Schwannoma | 10 (14) |
| | Fibrous histiocytoma | 18 (15) | Fibrous histiocytoma | 45 (16) | Fibrous histiocytoma | 71 (15) | Neurofibroma | 9 (13) |
| | Nodular fasciitis | 12 (10) | Neurofibroma | 37 (13) | Hemangioma | 52 (11) | Hemangiopericytoma | 8 (11) |
| | Hemangioma | 9 (7) | Schwannoma | 19 (7) | Neurofibroma | 38 (8) | Lymphangioma | 8 (11) |
| | Lipoma | 8 (7) | Fibromatosis | 11 (4) | Lipoma | 21 (5) | Ganglioneuroma | 6 (8) |
| | Hemangiopericytoma | 8 (7) | Lipoma | 10 (4) | Schwannoma | 17 (4) | Hemangioma | 4 (6) |
| | Other | 29 (24) | Other | 56 (20) | Other | 79 (17) | Other | 12 (17) |

**TABLE 2: Distribution of Common Benign Soft-Tumors By Anatomic Location and Age (continued)**

| Age (yrs) | Hip, Groin & Buttocks | No. (%) | Head and Neck | No. (%) | Trunk | No. (%) | Retroperitoneum | No. (%) |
|---|---|---|---|---|---|---|---|---|
| 26–45 | Lipoma | 57 (17) | Lipoma | 168 (29) | Lipoma | 178 (19) | Schwannoma | 38 (23) |
| | Neurofibroma | 38 (12) | Nodular fasciitis | 145 (19) | Nodular fasciitis | 150 (16) | Fibromatosis | 30 (18) |
| | Fibrous histiocytoma | 37 (11) | Fibrous histiocytoma | 137 (18) | Fibromatosis | 148 (16) | Hemangiopericytoma | 25 (15) |
| | Fibromatosis | 36 (11) | Hemangioma | 97 (13) | Fibrous histiocytoma | 98 (10) | Neurofibroma | 13 (8) |
| | Nodular fasciitis | 31 (9) | Neurofibroma | 57 (8) | Hemangioma | 78 (8) | Angiomyolipoma | 10 (6) |
| | Hemangiopericytoma | 24 (7) | Hemangiopericytoma | 37 (5) | Neurofibroma | 65 (7) | Hemangioma | 9 (5) |
| | Myxoma | 22 (7) | Schwannoma | 27 (4) | Schwannoma | 51 (5) | Sclerosing retroperitonitis | 7 (4) |
| | Other | 83 (25) | Other | 91 (12) | Other | 180 (19) | Other | 34 (20) |
| 46–65 | Lipoma | 76 (35) | Lipoma | 306 (46) | Lipoma | 290 (44) | Schwannoma | 33 (19) |
| | Myxoma | 36 (17) | Nodular fasciitis | 66 (10) | Fibromatosis | 63 (9) | Fibromatosis | 25 (14) |
| | Fibrous hystiocytoma | 17 (8) | Hemangioma | 55 (8) | Nodular fasciitis | 44 (7) | Sclerosing retroperitonitis | 25 (14) |
| | Schwannoma | 17 (8) | Fibrous histiocytoma | 42 (6) | Hemangioma | 31 (5) | Hemangiopericytoma | 21 (12) |
| | Nodular fasciitis | 11 (5) | Neurofibroma | 30 (4) | Fibrous histiocytoma | 29 (4) | Angiomyolipoma | 12 (7) |
| | Hemangiopericytoma | 11 (5) | Schwannoma | 25 (4) | Neurofibroma | 28 (4) | Lipoma | 10 (6) |
| | Hemangioma | 9 (4) | Myxoma | 23 (3) | Schwannoma | 28 (4) | Paraganglioma | 9 (5) |
| | Other | 40 (18) | Other | 120 (18) | Other | 151 (23) | Other | 40 (23) |
| 66 and over | Lipoma | 22 (21) | Lipoma | 158 (50) | Lipoma | 124 (42) | Schwannoma | 19 (26) |
| | Myxoma | 16 (15) | Hemangioma | 22 (7) | Fibromatosis | 26 (9) | Hemangiopericytoma | 14 (19) |
| | Neurofibroma | 13 (12) | Schwannoma | 18 (6) | Neurofibroma | 20 (7) | Lipoma | 6 (8) |
| | Schwannoma | 10 (9) | Fibrous histiocytoma | 17 (5) | Schwannoma | 18 (6) | Mesothelioma | 6 (8) |
| | Hemangiopericytoma | 10 (9) | Neurofibroma | 16 (5) | Elastofibroma | 17 (6) | Sclerosing retroperitonitis | 5 (7) |
| | Hemangioma | 8 (8) | Nodular fasciitis | 13 (4) | Myxoma | 16 (5) | Fibromatosis | 4 (6) |
| | Nodular fasciitis | 4 (4) | Myxoma | 12 (4) | Hemangioma | 14 (5) | Paraganglioma | 4 (6) |
| | Other | 23 (22) | Other | 58 (18) | Other | 61 (21) | Other | 14 (19) |

[a] 21 (22) indicates there were 21 cases of fibromatosis in the hand and wrist of patients 0–5 years old and this represented 22% of all benign tumors in this location and age group.

[b] Giant cell tumor of tendon sheath.

[c] Pigmented villonodular synovitis.

There is an inherent bias in any referral population. The consultative nature of the cases also introduces the potential for a significant bias with a preference for difficult case material. This may be responsible for the relatively high percentage of malignant tumors (approximately 38%). This percentage is greater than the 15.5% noted by Lattes [7], citing records from Columbia University during the 45 1/2 years from February 1, 1906, to September 1, 1951 (1349 malignant and 7337 benign lesions), and considerably greater than the 5.1% reported by Myhre-Jensen [8] during the 7-year period from April 1970 to April 1977 (72 malignant and 1331 benign lesions), at the University Institute of Pathology, Aarhus, Denmark. This discrepancy was especially great in lesions such as lipoma and ganglion. In the series reported by Myhre-Jensen [8], lipoma represented almost half of all lesions. Lipomas represent 16% of the lesions in the current study. Ganglion has been reported to represent as many as 33–60% [9, 10] of all hand tumors, but comprised only 3% of the hand and wrist lesions, and less than 1% of all lesions in this study. It is not surprising that such lesions would be uncommon in a referral population.

Review of the relative predilection of tumors for specific locations and age groups shows that 80% of lesions (range, 63–100%), can be placed in seven diagnostic groups. For example, in the retroperitoneum, lipoblastoma is the most common benign tumor in children 5 years old or less. Although lipoblastoma is a relatively rare lesion, comprising only 0.6% of all benign tumors, it makes up 37% of all benign tumors in this age group. Some of the diagnoses listed as "common" may be unfamiliar to radiologists. It must be emphasized that the data in Tables 1 and 2 reflect lesions found at biopsy. Many small superficial lesions are excised or sampled without imaging. Lesions in this group include fibrous histiocytoma, nodular fasciitis, granuloma annulare, and so forth.

The purpose of this article is to establish the relative prevalences of benign soft-tissue tumors and to identify preferential locations and age groups for specific entities. When a lesion's imaging appearance is nonspecific, knowledge of the tumor's prevalence, the patient's age, and the location of the lesion will allow a suitably ordered differential diagnosis.

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## REFERENCES

1. Crim JR, Seeger LL, Yao L, Chandnani V, Eckardt JJ. Diagnosis of soft-tissue masses with MR imaging: can benign masses be differentiated from malignant ones? *Radiology* **1992**;185:581–586
2. Berquist TH, Ehman RL, King BF, Hodgman CG, Ilstrup DM. Value of MR imaging in differentiating benign from malignant soft-tissue masses: study of 95 lesions. *AJR* **1990**;155:1251–1255
3. Kransdorf MJ, Jelinek JS, Moser RP, et al. Soft-tissue masses: diagnosis using MR imaging. *AJR* **1989**;153:541–547
4. Enzinger FM, Lattes R, Torloni R. *Histological typing of soft tissue tumors.* Geneva: World Health Organization, **1969**
5. Enzinger FM, Weiss SW. *Soft tissue tumors,* 2nd ed. St. Louis: Mosby, **1988**:1–18
6. Sundaram M, McLeod RA. MR imaging of tumor and tumorlike lesions of bone and soft tissue. *AJR* **1990**;155:817–824
7. Lattes R. *Tumors of the soft tissue,* 2nd ser. Washington, DC: Armed Forces Institute of Pathology, **1982**
8. Myhre-Jensen O. A consecutive 7-year series of 1331 benign soft tissue tumors: clinicopathologic data—comparison with sarcomas. *Acta Orthop Scand* **1981**;52:287–293
9. Bogumill GP, Sullivan DJ, Baker GI. Tumors of the hand. *Clin Orthop* **1975**;108:214–222
10. Butler ED, Hamill JP, Seipel RS, De Lormier AA. Tumors of the hand: a ten-year survey and report of 437 cases. *Am J Surg* **1960**;100:293–302