Hand tumors: A review of 186 patients at a single institute

Taketsugu Fujibuchi®, Hiroshi Imai, Joji Miyawaki, Teruki Kidani, Hiroshi Kiyomatsu and Hiromasa Miura

Abstract

**Purpose:** The spectrum of diagnoses and clinical features of hand tumors differ from those of tumors in other body parts. However, only a few reports have comprehensively referenced the diagnosis and clinical features of hand tumors. This study aimed to elucidate the diagnostic distribution and the clinical features of hand tumors undergone surgery in our institute. **Patients and methods:** A total of 235 lesions in 186 patients diagnosed with hand tumors between 1978 and 2020 were reviewed. Age at surgery, gender, chief complaint, tumor location, and pathological diagnosis were analyzed. **Results:** There were 121 benign bone tumors, 98 benign soft tissue tumors, and 16 malignant tumors. Chondroma and tenosynovial giant cell tumor were common benign bone and soft tissue tumors at the proximal phalanx of the ring finger and the palm, respectively. Meanwhile, chondrosarcoma and synovial sarcoma were common malignant tumors at the dorsal part of the hand. Local pain and painless mass were the chief complaints in patients with benign bone and soft tissue tumors, respectively. Most patients with malignant tumors were referred after unplanned resection. When patients were classified into two categories by tumor size according to maximal diameter, tumors larger than 19 mm had a significantly higher risk of malignant (p = 0.031) despite being smaller than other tumors in different body parts. **Conclusion:** When a tumor malignancy is suspected, the patient should be referred to a specialist to avoid unplanned resection or delayed diagnosis due to misdiagnosis. Knowing the distribution and clinical features should help in diagnosing hand tumors.

Keywords
diagnosis, hand, neoplasms, sarcoma

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Introduction

The hands are highly sophisticated and specialized body parts. As their construction and function are complex, the diagnosis and treatment for diseases affecting them need special knowledge and skills, particularly bone and soft tissue tumors of the hands.

However, bone and soft tissue tumors arising the hands are relatively uncommon. Altogether, 47,307 cases of bone tumors including tumor-like lesions and a total of 63,172 cases of soft tissue tumors were registered between 2006 and 2017 in the bone and soft tissue tumor registry in Japan. Of these, 3129 (6.6%) and 5175 (8.2%) cases were arising in the hands, respectively. The spectrum of diagnoses, clinical features, and treatment of such tumors differ from those of other body parts. Most reports on hand tumors were case reports or small case series. Only a few reports have comprehensively referenced the clinical features and diagnosis of hand tumors. Hence, limited information and knowledge might lead to misdiagnosis, particularly in malignant tumors, unplanned resection or delayed diagnosis resulting in patients’ disadvantage.

Department of Bone and Joint Surgery, Ehime University Graduate School of Medicine, Shitsukawa, Toon, Ehime, Japan

Corresponding author:
Taketsugu Fujibuchi, Department of Bone and Joint Surgery, Ehime University Graduate School of Medicine, Shitsukawa, Toon, Ehime 791-0295, Japan.
Email: bучi@m.ehime-u.ac.jp

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We retrospectively reviewed the distribution of pathological diagnoses and the clinical features of 186 patients affected by hand tumors who underwent surgical treatment at our institute. We also discussed how to avoid misdiagnosis on hand tumors.

Patients and methods
We retrospectively reviewed 186 patient records of surgery for pathologically diagnosed hand tumors at our institute from 1978 to 2020. The indications for surgery were cases at risk of pathological fracture, cases that interfered with daily life, cases with unclear diagnosis, and cases that the patient wished to undergo excision. Primary bone and soft tissue tumors and tumor-like lesions were included, while skin tumors, infectious diseases, and reactive lesions were excluded. Data of 94 men and 92 women with a mean age of 39.8 years at surgery (range: 2–91) were analyzed. Some patients had multiple lesions such as multiple osteochondromatosis. Consequently, the total number of tumors analyzed was 235 lesions. Age at the time of surgery, gender, location, tumor size, chief complaint, and pathological diagnosis were collected from the case records and tumor databases. Location was classified by bones of the hands in bone tumor cases, and the finger, palm, or back of the hands in soft tissue tumors. Tumor size was defined as the maximum diameter of the tumor on radiological imaging. Maximum diameter of all soft tissue tumors was assessed by MRI. As for bone tumors, assessment of diameter was basically performed by MRI except for some cases of osteochondromas, and they were evaluated by plain X-ray or CT.

All 235 lesions in 186 patients were subjected to the analysis of age at surgery, gender, chief complaint and pathological diagnosis, and exception of analysis of maximal tumor size. Tumor location was analyzed in primary lesions. Analysis of maximal tumor size was performed only in 141 tumors which underwent surgery after April 2003, because radiological images of old cases were unavailable and excluded. Moreover, a case after unplanned resection was also excluded from analyses of maximal tumor size.

The institutional review board of Ehime University Hospital approved the present retrospective case series study (No. 1408024). Informed consent was waived due to the retrospective nature of this study.

Statistical analysis
Continuous parameters of clinical data, age, and maximal tumor size were categorized by determining optimal threshold using receiver operative characteristic (ROC) curve, and the data of tumors were classified into two groups. The possibility of malignancy based on patient’s age and tumor size was analyzed by Fisher’s exact test. The survival rate was analyzed by the Kaplan–Meier method and log-rank test. Statistical analyses were performed using JMP® 14 (SAS Institute Inc., Cary, NC, USA). A p value of <0.05 was considered statistically significant.

Results
Benign bone tumors and tumor-like lesions
One hundred twenty one lesions in 88 patients were included in the group of benign bone tumors or tumor-like lesions. Among them, 45 lesions in 14 patients had multiple lesions, and 2 lesions were recurrent tumors. This group included 43 men and 45 women with a mean age of 29.5 years. The most common histological diagnosis was chondroma such as enchondroma and periosteal chondroma, followed by multiple osteochondromatosis and multiple chondromas (Table 1). The proximal phalanx of the ring finger was the most common location followed by that of the little finger. The most common phalanx was the proximal phalanx, and the most common finger ray was the ring finger (Table 2). Lesions of multiple osteochondromatosis were found in long bones or flat bones throughout the body in addition to the hands, whereas those of multiple chondromas were all in hand only. The most common complaint was local pain, and approximately one third of them had pathological fracture (Table 3).

Benign soft tissue tumors
Ninety eight lesions in 83 patients were classified as benign soft tissue tumors. Among them, one patient with multiple hemangiomas had 12 lesions, one patient had two tumors, and three lesions were recurrent tumors. This group included 42 men and 41 women with a mean age of 48.7 years. The most common histological diagnosis was localized type of tenosynovial giant cell tumor, followed by fibroma and multiple hemangioma (Table 1). The palm was the most common location, followed by the thumb (Table 2). The most common complaint was painless mass (Table 3).

Malignant tumors
Sixteen lesions of 15 patients were diagnosed as malignant tumors. One lesion of synovial sarcoma had a local recurrence. Nine patients were male, and six were female with a mean age of 50.9 years. Malignant bone tumors were observed in four patients, and all tumors were diagnosed as chondrosarcoma. Of the four cases of chondrosarcoma, there were three cases of grade 1, there was one case of grade 2. Meanwhile, malignant soft tissue tumors were observed in 11 patients, and the diagnoses were synovial sarcoma, malignant fibrous histiocytoma, myxofibrosarcoma, and rhabdomyosarcoma (Table 1). The most common location of malignant soft tissue tumor was the dorsal part of the hand, followed by the palm (Table 2). There were 11 patients who underwent unplanned resection. Most of initial diagnoses before unplanned resection were
Table 1. Diagnosis of hand tumors.

| Benign bone tumors                  | Number of lesions | Number of patients | Benign soft tissue tumors | Number of lesions | Number of patients | Malignant tumors | Number of lesions | Number of patients |
|-------------------------------------|-------------------|--------------------|--------------------------|-------------------|--------------------|------------------|-------------------|--------------------|
| Chondromas (enchondroma,            | 61                | 59                 | Tenosynovial giant cell   | 29                | 27                 | Chondrosarcoma   | 4                 | 4                  |
| periosteal chondroma)               |                   |                    | tumor, localized type     |                   |                    |                  |                   |                    |
| Multiple osteochondromatosis        | 24                | 9                  | Multiple hemangioma       | 12                | 1                  | Synovial sarcoma | 4                 | 3                  |
| Multiple chondroma                  | 19                | 4                  | Fibroma                   | 13                | 12                 | MFH              | 2                 | 2                  |
| Osteochondroma                      | 8                 | 8                  | Schwannoma                | 10                | 9                  | Myxofibrosarcoma | 2                 | 2                  |
| Simple bone cyst                    | 4                 | 3                  | Hemangioma                | 9                 | 9                  | Rhabdomyosarcoma | 2                 | 2                  |
| Others                              | 5                 | 5                  | Lipoma                    | 6                 | 6                  | Angiosarcoma     | 1                 | 1                  |
|                                     |                   |                    | Glomus tumor              | 5                 | 5                  | Epithelioid sarcoma | 1         | 1                  |
|                                     |                   |                    | Others                    | 14                | 14                 |                  |                   |                    |
| Total                               | 121               | 88                 | Total                     | 98                | 83                 | Total            | 16                | 15                 |

Table 2. Locations of hand tumors.

| Benign bone tumors                  | Number of lesions | Thumb | Index finger | Middle finger | Ring finger | Little finger | Total by phalanx | Benign soft tissue tumors | Number of lesions | Thumb | Palm | Dorsal part of hand | Both palm and dorsal | Other than fingers total | Malignant bone tumors | Number of lesions | Thumb | Palm | Dorsal part of hand | Malignant soft tissue tumors total | Malignant tumor total |
|-------------------------------------|-------------------|-------|--------------|---------------|-------------|---------------|-------------------|--------------------------|-------------------|-------|------|------------------|----------------------|-----------------------|----------------------|-------------------|-------|------|------------------|----------------------|----------------------|
| Phalanx bones                       | 87                | 0     | 0            | 3             | 1           | 4             | 8                 | Thumb                    | 14                |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Dist. phal.                         |                   |       |              | 8             | 9           | 3             | 23                | Index finger            | 9                 |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Middle phal.                        |                   |       |              | 3             | 12          | 11            | 15               | 13                      | Middle finger           | 8                 |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Prox. phal.                         |                   |       |              | 3             | 16*         | 22            | 25               | 21*                     | Ring finger             | 6                 |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Total by ray                        |                   | 14*   | 7            | 5             | 5           | 6             | Total by phalanx    | Fingers total            | 46                |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 1st                                 |                   |       | 7            | 5             | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 2nd                                 |                   |       |              | 5             | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 3rd                                 |                   |       |              | 7             | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 4th                                 |                   |       |              | 8             | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 5th                                 |                   |       |              | 11            | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Metacarpal bone                     | 29                | 4     | 7            | 7             | 5           | 6             | Total by phalanx    | Fingers total            | 46                |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 1st                                 |                   |       | 7            | 5             | 6           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 2nd                                 |                   |       |              | 7             | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 3rd                                 |                   |       |              | 11            | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 4th                                 |                   |       |              | 11            | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| 5th                                 |                   |       |              | 11            | 5           | 6             |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Carpal bone                         | 3                 |       |              | 1             | 2           |               |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Capitate                           |                   |       |              |               |             |               |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Hamate                              |                   |       |              |               |             |               |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |
| Benign bone tumors total            | 119               |       |              |               |             |               |                   |                          |                   |       |      |                 |                      |                       |                      |                   |       |      |                 |                      |                      |

*= Including details of unknown case.
unclear. In the known range, their initial diagnoses were enchondroma for some chondrosarcomas, and ganglion cyst, tenosynovial giant cell tumor, or fibroma for some soft tissue sarcomas. The chief complaint of all newly diagnosed patients was painless mass (Table 3).

Wide resection or additional wide resection were performed in nine lesions to preserve the affected limb. Amputations including ray amputation and forearm amputation were required in seven lesions. One lesion of synovial sarcoma had a local recurrence and was undergone wide resection again. Chemotherapy was performed in one patient with synovial sarcoma and both radiation therapy and chemotherapy in two patients with rhabdomyosarcoma. The 5-year disease-specific survival rate for all patients was 85.6\%. It was 83.3\% for patients who had undergone resection and 85.7\% for those who had undergone an amputation (Figure 1). The 5-year disease-free survival rate for all patients was 69.1\%. It was 62.5\% for patients who had undergone tumor resection and 71.4\% for those who had undergone an amputation (Figure 2).

No significant difference was observed between the two groups in disease-specific ($p = 0.96$) and disease-free ($p = 0.98$) survival.

**Differentiation between benign and malignant tumors**

Because of the small number of cases of malignant bone tumors, bone and soft tissue tumors were analyzed together. The mean age was 38.8 years in patients with benign bone and soft tissue sarcomas and 50.9 years old in patients with malignant bone and soft tissue tumors. The mean maximal diameter of benign tumors was 17.8 mm and that of malignant tumors was 29.2 mm. Optimal thresholds for distinguishing benign and malignant tumors according by ROC curve were 35 years of age and 19 mm of maximal diameter. According to this threshold, patients were classified into two categories. A significant association was observed between the diagnosis of benign or malignant and age ($p = 0.014$) and maximal tumor size ($p = 0.031$) (Table 4).

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**Table 3. Chief complaint at first visit of hand tumors.**

| Benign bone tumors | Number of lesions | Benign soft tissue tumors | Number of lesions | Malignant tumors | Number of lesions |
|--------------------|-------------------|---------------------------|-------------------|------------------|------------------|
| Mass only          | 38                | Mass only                 | 66                | Previously unplanned resection + recurrent mass | 1                |
| Mass + deformity   | 6                 | Mass + pain               | 4                 | Previously unplanned resection + recurrent mass + pain | 1                |
| Mass + pain        | 2                 | Mass + ROM limitation     | 1                 | Post unplanned resection, residual mass (+) | 4                |
| Mass + ROM limitation | 1             | Pain only                 | 8                 | Post unplanned resection, residual mass (−) | 5                |
| Pain only          | 19                | Pain + swelling           | 2                 | Mass             | 4                |
| Pain + impending fx. | 21          | Pain + recurrent mass     | 1                 | Recurrent mass (post operation in our institute) | 1                |
| Pain + patho. fx.  | 23                | Recurrent mass            | 10                |                  |                  |
| Recurrent mass     | 1                 | Swelling                  | 5                 |                  |                  |
| Swelling           | 3                 | ROM limitation            | 1                 |                  |                  |
| Deformity          | 2                 |                           |                   |                  |                  |
| Free               | 5                 |                           |                   |                  |                  |
| Total              | 121               |                           | 98                |                  | 16               |

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**Figure 1.** Disease-specific survival of malignant tumors.

**Figure 2.** Disease-free survival of malignant tumors.
Discussion

Here, the diagnoses and clinical characteristics of hand tumors undergone surgery including benign tumors were revealed. There have been a few educational reviews on malignant tumors, and only a few reports have comprehensively analyzed hand tumors including benign tumors. Bone tumor and tumor-like lesions account for 6.6% of all bone tumors, and soft tissue tumors accounts for 8.2% of all soft tissue tumors according to the Japanese registration. In the series of the textbook of Dahlin’s Bone tumors, bone tumors of the hands were reportedly 290 cases of 9973 cases (2.9%). Some reports cited the incidence of soft tissue tumors of the hands as approximately 15%. Thus, incidence of tumors was varied as available information was limited in the literature for an epidemiological analysis of bone and soft tissue tumors.

The most common diagnosis of benign bone tumor was chondroma including enchondroma and periosteal chondroma, whereas that of benign soft tissue tumors was localized type of tenosynovial giant cell tumor. These findings are similar to those of past reports. Among malignant bone and soft tissue tumors, the most common diagnosis was chondrosarcoma and synovial sarcoma, respectively. In this series, the number of malignant tumors was small; osteosarcoma and Ewing sarcoma are relatively common malignant bone tumors of the hand and liposarcoma, malignant fibrous histiocytoma, and dermatofibrosarcoma protuberans are relatively common malignant soft tissue tumors of the hands. Although it is rare, metastasis of carcinoma, especially lung cancer, can develop in the distal phalanx.

In this study, we also analyzed the chief complaint of patients and detailed locations. The most common chief complaint was local pain due to pathological or impending fracture among bone tumor patients and a painless mass in soft tissue tumor patients. These symptoms may be typical initial symptoms of bone and soft tissue tumors of the hands. Many patients with malignant tumor were referred to our hospital after unplanned resection. Other than them, all patients with malignant tumor presented a mass. Campbell et al. reported that the majority of benign and malignant bone tumors of the hands initially presented with pain with swelling, pain alone, or fracture. As for tumor location, benign bone tumor often developed in the proximal phalanges. Conversely, bone tumors in carpal bones were very rare. This distribution is similar to past reports. Benign soft tissue tumors arose almost equally among the digits, the palm or the dorsal side of the hands. The thumb was most common location among the digits, and the palm was more common than the dorsal side of the hand. In malignant soft tissue tumor patients, the palm or dorsal side of the hands were equally a common location.

Although the number of patients with malignant tumors was small, therapeutic outcome of malignant hand tumors in this study was similar to those reported by previous reports. Bray et al. stated that limb salvage surgery and radiation therapy was an effective alternative to amputations. In contrast, Puhanindran et al. reported on the efficacy of single ray amputation and partial hand preservation surgery for sarcomas of the hands. We could not find a significant difference between the resection and amputation groups in terms of disease-specific survival and disease-free survival.

The significance of age on diagnosis of malignancy varies for different studies. In this study, the patients older than 35 years old had a significantly high risk of a malignant diagnosis. However, chondrosarcoma, which generally develops in older patients, was the most common in malignant bone tumors, whereas synovial sarcoma and rhabdomyosarcoma which were common malignant soft tissue tumors generally develop in adolescent-young adults. Thus, in the condition that bone and soft tissue tumor were analyzed together, it is expected that there may be some kind of problem.

In general, a large tumor is suspected to be malignant. In all soft tissue tumors, maximal tumor size more than 5.6 cm is one of the predictive factors for malignant tumor. However, the mean size of a malignant tumor of the hands identified in this study was 29.2 mm. According to the ROC curve on tumor size, the thresholds for distinguishing benign or malignancy was 19 mm. This threshold was by far smaller than that in all soft tissue tumors. There may be a problem that bone tumor and soft tissue tumor had been analyzed together, although hand tumors may be a risk of malignant tumors regardless of smaller tumor size.

In this study, 73.3% of patients were consulted in our institute after unplanned resection. Reportedly, 68% of patients with distal upper extremity sarcoma have received previous treatment and that 95% of patients with sarcomas of the hands and feet are referred after previous
treatment. Essential organs such as nerves, blood vessels, and tendons lie in the narrow space in the hands. If barriers around the tumors have been broken by unplanned resection, the margins would be compromised easily. Thus, an unplanned excision makes it difficult to maintain clear margins in additional excisions. Resection with an inadequate surgical margin results in a 12 times greater risk of local recurrence, a three times greater risk of metastasis, and a five times greater risk of death than that with an adequate margin. When a tumor is suspected for malignancy, or unclear whether benign or malignant, the patient must consult a specialist in bone and soft tissue tumors and hand surgery to avoid unplanned resection or delayed diagnosis due to misdiagnosis. Clinicians should be aware of the peculiarities of hand tumors, to perform oncologically and anatomically adequate treatment.

This study has some limitations. First, the number of patients with malignant tumors was small. Therefore, some element of bias existed in our study. In connection with that problem, malignant bone tumor and soft tissue tumor were analyzed together. It was considered to have an influence on the analysis of the relationship between diagnosis and age. Second, data regarding some items could not be collected, particularly in old cases because the study period was long. Old cases were omitted from the analysis of maximal tumor size. Although the number of cases decreased, significant results on the association between diagnosis and maximal tumor size of hand tumors could be revealed. Third, conservatively managed cases of benign tumors and skin tumors such as squamous cell carcinoma and malignant melanoma, which are ones of common hand tumors, were excluded from this study, thus this case series might not show the correct distribution and representation of all hand tumors. However, this case series gives the correct distribution and representation of surgical cases of primary bone and soft tissue tumors and tumor-like lesions.

**Conclusion**

Chondroma and tenosynovial giant cell tumor were common benign tumors, and chondrosarcoma and synovial sarcoma were common malignant hand tumors. Most of patients with a malignant tumor were referred to us after unplanned resection. Tumors larger than 19 mm had a significantly higher risk being malignant. Hand tumors may be malignant regardless of size. When a tumor malignancy is suspected, the patient must consult a specialist on bone and soft tissue tumors and hand surgery to avoid misdiagnosis.

**Declaration of conflicting interests**

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