A comparative analysis of hand sarcoma by anatomical site: A case series

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Abstract. Hand sarcomas are very rare, and few studies have focused on their anatomical distribution, such as involvement of the fingers vs. the palm/dorsum (PD). The present study reviewed 24 cases of hand sarcomas identified from medical records of National Cancer Centre Hospital (Tokyo, Japan) between January 2010 and December 2022, examining sex, age, maximum tumour size, metastasis, histology, origin (bone vs. soft tissue), pain, biopsy performance, unplanned excision at previous institutes, treatment (surgery including reconstructive procedures, chemotherapy, and radiotherapy) and prognosis. The patients were divided into two groups, finger and PD, to facilitate comparison. Among the 24 cases, 9 occurred in the fingers and 15 occurred in the PD. Soft tissue was involved in 21 cases, while 3 cases arose from the bone, all in the fingers. Pain was present in 11 cases, with 6 cases (33%) in the fingers and 5 cases (66%) in the PD group. Synovial sarcoma, the most common histological subtype among the series, occurred exclusively in the PD group (n=7). In the finger group, 9 patients were managed with amputation, and only one received adjuvant therapy. In contrast, 10 of the 15 PD sarcomas underwent wide resection with reconstruction, and 6 received chemo- or radiotherapy. Overall, hand sarcomas had a favourable prognosis, with 86% overall survival and 77% disease-free survival rates; however, pleomorphic spindle cell sarcoma exhibited an exceptionally poor prognosis. In conclusion, synovial sarcoma was more prevalent in the PD region and finger sarcomas exhibited a slight tendency to cause pain. Treatment strategies varied significantly between the finger and PD groups.

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Introduction

Sarcomas arising from the hands are rare. According to a single-institutional descriptive study, the hand was the primary location of soft tissue sarcomas (STSs) of the upper extremity in approximately 2% of cases (1). Although no specific data are available, it is safe to assume that hand sarcomas originating from the bone are even rarer than those originating from hand STSs. Furthermore, because histological subtypes of hand sarcoma vary from relatively common entities, such as synovial sarcoma, to those of the minority, it is difficult to achieve a consensus and evidence on how to optimize the diagnostic process or manage each case in daily clinical practice. While limb-sparing surgery with wide resection is the mainstay for treating bone and soft tissue sarcoma, there is a conventional mindset accepted by clinicians that, in some acral cases, limited volume of tissue allows us scarce additional surgical margins, unavoidably resulting in amputation (2,3). However, which anatomical site of origin or histological subtype makes hand sarcoma more appropriate for amputation than wide resection plus reconstructive surgery is unclear.

Only a few case series or retrospective studies discussing acral sarcoma have been published, some of which focused on hand or wrist cases, while others enrolled both hand and foot sarcomas together (1-5). To the best of our knowledge, no previous studies have highlighted the anatomical distribution of its occurrence in the hand.

To clarify the clinical differences among various conditions of occurrence, we describe the results of 24 bone and soft tissue hand sarcomas treated at our institute, classifying them into groups of finger sarcomas and palm/dorsum (PD) sarcomas.

Materials and methods

We retrospectively identified 25 patients with bone and soft tissue sarcomas of the hand by surveying the electronic medical records database of National Cancer Centre Hospital (Tokyo, Japan) between January 2010 and December 2022. The patients eventually received a definitive diagnosis and clinical management at a single institute, regardless of treatment at previous

hospitals. One metastatic case of primary intimal sarcoma of the cardiac muscle was excluded from the study design. For the 24 eligible cases, patient sex and age, maximum tumour size, metastasis at the first presentation, and histologic subtype were evaluated.

Patients were divided into finger and PD sarcoma groups.'Finger' is defined as the region distal to metacarpal (MCP) joints and including thumb, while 'palm/dorsum' refers to the anatomical area distal to the wrist joint but proximal to the MCPs. According to this definition, the carpus belongs to the PD region. The study also evaluated whether the lesion is of bone origin or soft tissue origin.

In addition, we assessed the presence of pain at the time of the first visit. Some patients underwent resection before being referred to our institute, whereas others were left untreated with or without biopsy. Therefore, biopsy and treatment history (unplanned resection) were included in the analysis. The surgical treatment each patient received in our hospital was reviewed in detail, distinguishing amputations from limb-sparing surgery and reconstruction. For each case, the evaluation of the surgical margin status was recorded according to the pathologists' reports. If performed, chemotherapy or radiotherapy was recorded as adjuvant or neoadjuvant treatment.

All surviving patients were followed-up at least annually. Patients treated more than five years ago visited our outpatient clinic for a minimum period of five years, but some recently treated patients were followed up for as long as possible. The overall survival (OS) and disease-free survival (DFS) were assessed using the Kaplan-Meier method. For some of the survey items listed above, Fisher's exact test was used to test the differences between the finger and PD groups. Statistical significance was set at $P<0.05$.

All statistical analyses were performed using the JMP software program 13.2.0 (SAS Institute Inc., Cary, NC, USA). The study was designed in accordance with the ethical standards of our institution and the 1964 Declaration of Helsinki. As per our institutional standards, formal patient consent was not required for this type of study.

Results

Primary patient demographics, including sex, age, tumour size, pain, and histological site of origin (bone or soft tissue), are shown in Table I. The patients presented with a mean tumour size of 32.5 (range: 7-179) mm. Of the 24 cases, nine arose in the fingers and 15 in the PD. None of the patients showed thumb involvement. Twenty-one patients had soft tissue occurrence, whereas the remaining three arose from the bone. All three bone sarcomas developed in the fingers. Four patients had lung or bone metastasis at the first presentation, and one had a different type of neoplastic disease in the lung. The tumours were painful at the first visit in 11 cases, with six cases (33%) of finger occurrence and five cases (66%) of PD. There was no statistically significant difference in pain between the finger and the PD groups ($P=0.20$). Seventeen patients (71%) underwent resection before being referred to our institute, unaware of the fact that the disease was malignant. Among these 17 cases, the margin status after previous resection was unknown in 5 cases, while the remaining 12 cases had R1 or R2 margins. For 13 cases, a biopsy was planned before treatment, only two of which were performed in previous hospitals. Six cases required a biopsy of recurrent lesions at our institute, as definite pathological diagnoses were unavailable from the previous unplanned resection. As a result, only 5 patients underwent primary biopsies at our specialized institution. In terms of the biopsy method, all 13 cases were diagnosed using open biopsy instead of needle biopsy.

Histological findings are presented in Table I. Synovial sarcoma was the most frequent histological diagnosis, accounting for approximately 30% (seven cases) of the 24 cases. The remaining 17 cases were diverse and heterogeneous, with two epithelioid sarcomas and one case each of various histologies, such as osteosarcoma, chondrosarcoma, and other rarer entities. Surprisingly, all seven synovial sarcomas developed in the PD region, accounting for almost half of the 15 PD cases.

Table II summarizes the treatments used in these cases. Eighteen patients underwent surgery at our institute for chief management of the diseases. Of the six patients managed non-surgically, two received chemotherapy and two underwent radiotherapy only, mainly because of remote metastasis; the remaining two patients refused surgery and were followed up without any additional treatment. Six patients had a history of unplanned excisions. Amputations were performed for 12 of 18 cases, while for ten cases, some kind of reconstruction surgery, such as the tendon transfer procedure or skin flap technique, was followed by primary resection had been performed. Amputation was the surgical management applied for all six finger sarcoma cases. In contrast, all ten cases that underwent wide resection plus reconstruction were PD ($P<0.01$). Among them, nine patients received flap transplantation, all of which required vascular anastomosis, while one patient was treated with simple tendon transfer surgery. In terms of surgical margin status, only one case was reported to have been resected with the R1 condition, while the other 11 achieved R0 clearance.

Chemotherapy or radiotherapy was introduced in some cases; one of the nine finger cases (11%) received adjuvant chemotherapy, and another patient received radiotherapy. In contrast, six of 15 PD cases (40%) were treated with chemotherapy, and five patients (33%) were treated with radiotherapy. Two patients underwent neoadjuvant and adjuvant chemotherapies. There was no statistically significant difference in additional therapies between the finger (two cases) and PD groups (eight cases) ($P=0.19$). The estimated 5-year OS and DFS rates were 86 and 77%, respectively. The median follow-up time of the finger and PD subgroups was 23.5 months (interquartile range: 8.5-60 months) and 14.5 months (interquartile range: 52.5-59.5 months), respectively. We found no remarkable differences in prognosis between the two subgroups. Sixteen patients had no evidence of disease at the time of the final observation, whereas three patients (clear cell sarcoma, osteosarcoma, and pleomorphic spindle cell sarcoma) died of the disease. In particular, among the five cases of pleomorphic sarcomas, not only did one case result in death due to the disease, but the remaining four also showed disease progression, exhibiting an exceptionally poor prognosis.

Table I. Demographics of all hand sarcomas.

Case no.	Finger/ PD	Sex	Age, years	Tumour size, mm	L/R	Pain	Bone/soft tissue	Histology	Metastasis	Biopsy	UE
1	Finger	M	41	25	L	Yes	Soft tissue	Clear cell sarcoma	Yes	No	Yes
2	Finger	M	75	42	R	Yes	Bone	Osteosarcoma (secondary)	Yes	Yes	No
3	Finger	F	49	7	L	Yes	Soft tissue	Myxoinflammatory fibroblastic sarcoma	No	No	Yes
4	Finger	M	38	5	R	Yes	Soft tissue	Epithelioid sarcoma	No	No	Yes
5	Finger	F	74	28	R	No	Bone	Chondrosarcoma	No	Yes	No
6	Finger	M	50	42	L	No	Bone	Angiomatoid fibrous histiocytoma	No	No	Yes
7	Finger	M	25	23	L	Yes	Soft tissue	SMARCB1-deficient sarcoma	No	Yes	No
8	Finger	M	17	10	L	No	Soft tissue	Histiocytic sarcoma	No	No	Yes
9	Finger	F	52	8	R	Yes	Soft tissue	Pleomorphic spindle cell sarcoma	No	Yes	Yes
10	PD	M	5	35	L	Yes	Soft tissue	Synovial sarcoma	No	Yes	No
11	PD	F	36	30	R	Yes	Soft tissue	CIC-rearranged sarcoma	No	Yes	Yes
12	PD	F	63	7	L	Yes	Soft tissue	Synovial sarcoma	No	No	Yes
13	PD	F	27	36	R	Yes	Soft tissue	Epithelioid sarcoma	No	Yes	No
14	PD	M	43	14	R	No	Soft tissue	Synovial sarcoma	No	No	Yes
15	PD	M	62	10	L	No	Soft tissue	Leiomyosarcoma	No	Yes	Yes
16	PD	M	49	179	R	No	Soft tissue	Pleomorphic spindle cell sarcoma	Yes	No	Yes
17	PD	F	71	47	R	No	Soft tissue	Synovial sarcoma	No	No	Yes
18	PD	F	46	10	L	No	Soft tissue	Myxofibrosarcoma	No	No	Yes
19	PD	M	53	23	L	No	Soft tissue	Synovial sarcoma	No	Yes	Yes
20	PD	F	13	36	L	No	Soft tissue	Synovial sarcoma	No	Yes	No
21	PD	F	74	37	R	No	Soft tissue	Pleomorphic spindle cell sarcoma	Yes	Yes	Yes
22	PD	M	67	61	L	Yes	Soft tissue	Pleomorphic spindle cell sarcoma	No	No	Yes
23	PD	M	80	45	R	No	Soft tissue	Pleomorphic spindle cell sarcoma	Yes	Yes	Yes
24	PD	M	32	69	R	No	Soft tissue	Synovial sarcoma	Yes	Yes	No

PD, palm/dorsum; LR, left/right; UE, unplanned excision.

Discussion

The hand is one of the rarest sites of origin for malignant neoplasms, and most mesenchymal tumours originating from the finger or carpus are benign (6). Malignant melanoma that involves the subungual regions is a more common primary malignancy in the hand, but it comprises only 0.3% of cutaneous melanomas recorded in an Australian national database (7). Metastases from carcinomas of other organs, especially the lungs, are infrequent but sometimes present as lytic bone lesions in the digits, accounting for 0.1% of all bone metastases (8,9). Since sarcomas occur in the hand much less often than other conditions, only a few reports have provided detailed information about the frequency, clinical features, optimal treatment, and prognosis of hand sarcoma. A 15-year review from a single regional sarcoma service showed that only 17 of 218 STSs of the upper limb involved the hand or wrist, and another author extracted ten finger cases from a 29-year review of 108 upper limb STSs, both of which convinced us of their super-rarity (4,5). Table III reviews and summarizes the relevant series published in English.

Sporadic case studies have reported that synovial sarcoma maintains a certain number of occurrences in the hand, estimated to account for 4-8.5% of all synovial sarcomas, often requiring additional chemotherapy (10-13). Remarkably, in accordance with the current study, some authors have suggested that when synovial sarcoma arises in the hand wrist, the incidence of finger involvement is less common than that of carpal or PD occurrence (14,15). Other subtypes of sarcoma arising in the hand region have not been extensively studied, as only a few meticulous reviews or cohorts on bone sarcomas of the hand are available in the literature (16-18).

Table II. Treatment for all hand sarcomas.

Case No.	Finger/PD	Surgery	Reconstruction	Margin status	Chemotherapy	Radiotherapy	Oncological outcome
1	Finger	Amputation	None	R0	None	Post	DOD
2	Finger	Amputation	None	R0	None	None	DOD
3	Finger	Amputation	None	R0	None	None	CDF
4	Finger	None			None	None	CDF
5	Finger	Amputation	None	R0	None	None	CDF
6	Finger	Amputation	None	R0	None	None	CDF
7	Finger	Amputation	None	R0	None	None	CDF
8	Finger	None			Adj	None	CDF
9	Finger	None			None	None	AWD
10	PD	Amputation	Flap, TT	R0	Adj, NAC	None	CDF
11	PD	Amputation	Flap	R0	Adj, NAC	None	CDF
12	PD	WR	Flap, TT	R0	None	None	CDF
13	PD	Amputation	TT	R0	None	Post	CDF
14	PD	WR	Flap, TT	R0	None	None	CDF
15	PD	WR	Flap, TT	R0	None	None	CDF
16	PD	Amputation	None	R0	Adj	None	AWD
17	PD	WR	Flap	R0	None	None	CDF
18	PD	WR	Flap	R0	None	None	CDF
19	PD	WR	Flap, TT	R0	None	Post	CDF
20	PD	Amputation	Flap	R1	NAC	Pre	CDF
21	PD	None			Adj	None	DOD
22	PD	None			None	Yes	AWD
23	PD	None			None	Yes	AWD
24	PD	Amputation	None	R0	Adj	Post	AWD

PD, palm/dorsum; WR, wide resection; TT, tendon transfer; R0, microscopic complete resection; R1, macroscopic complete resection; adj, adjuvant; NAC, neo-adjuvant chemotherapy; post, post-surgery; pre, pre-surgery; DOD, dead of disease; CDF, continuous disease free; AWD, alive with disease.

Furthermore, there is a paucity of previous studies that emphasize the clinical differences between the fingers and other anatomical sites of origin in the hand. Not only were synovial sarcomas prevalent in the PD region, but the present series also suggested that bone sarcomas exhibited a strange predilection for fingers, which conflicts with the predominant viewpoint that they often affect the metacarpals (17). Although clinicians are aware of some impressive situations, such as chondrosarcoma cases dedifferentiated from a pre-existing phalangeal enchondroma, it seems slightly puzzling that there was no single bone sarcoma arising from the PD region in our series (19). The small sample size made it difficult to provide a reasonable explanation for this anomalous uneven distribution. However, a diagnostic bias may have played a role, as bone tumours are more likely to cause noticeable deformities or pain when they occur in the fingers, making them easier to diagnose than soft tissue tumours. The prospective accumulation of cases through multicentre studies will provide a definitive conclusion for this discussion.

Although non-significant, finger sarcomas had a propensity to ache more frequently than PD sarcomas did. This may be because the finger is anatomically scarce in tissues where nerve compression or cytokine accumulation easily occurs. This is probably related to the fact that the finger has more than twice the nerve density of the PD region (20). In contrast, the PD group, which included four synovial sarcoma cases, presented with painless lesions. We believe that synovial sarcoma with a typical clinical presentation yields pain, with a frequency as high as 30% at the first visit (21,22). In contrast, Seto *et al* (23) suggested that synovial sarcoma presents with pain more frequently when located deeper than the subcutaneous tissue or near the joint, which may explain the painlessness of synovial sarcoma arising in the PD region. To provide a definitive answer to this question, multi-institutional studies involving a larger number of cases are required in the future.

Our results delineated two different patterns of general treatment algorithms, namely, those applied for finger sarcomas and PD sarcomas. PD patients were likely to be treated with more multidisciplinary management, including reconstructive procedures or adjuvant therapies, whereas all finger cases were simply treated with radical removal of the fingers. Again, this striking difference may be partially due to the anatomically distinctive characteristics of the finger, which lacks soft tissue as a margin or cuff to be resected with disease. Another reason is that even if radically removed, functional deficits are not as much of a problem with the fingers as they

Table III. Review of the literature.

Author	Published year	Number of cases	STS/BS	Number of BS cases	Study period, months	Study design (number of institutions)	(Refs.)
Creighton *et al*	1985	10	Both	3	11	Multi-inst. (5)	(18)
Gustafason and Arner	1999	10	STS		29	Population-based	(4)
Kawai *et al*	2002	13	Both	5	11	Single-inst.	(2)
Pradhan *et al*	2008	63	STS		14	Multi-inst. (3)	(1)
Nicholson *et al*	2018	17	STS		15	Single-inst.	(5)
Dean *et al*	2018	27	STS		17	Single-inst.	(3)
Lans *et al*	2021	64	STS		46	Single-inst.	(24)
Current study	2024	24	Both	3	13	Single-inst.	

STS, soft tissue sarcoma; BS, bone sarcoma; multi-inst., multi-institutional; single-inst., single-institutional.

are with other areas of the hand. Adjuvant/neoadjuvant therapies are not always mandatory for most sarcoma subtypes if the disease is controlled only by surgical removal. Therefore, patients with finger sarcomas are less likely to receive systemic or additional local therapy. For some PD cases not radically resected, these options were required depending on whether each histology was reactive or resistant to chemotherapy or radiation therapy.

Among the other sites of occurrence, hand sarcomas are prone to unplanned excision. Lans *et al* (24) reported that the unplanned excision rate for hand sarcomas was as high as 81%, which is similar to the reported result of 71%. Because bone and soft tissue tumours are, in most cases, small and benign, one-stage resection as an incisional biopsy, mainly for symptom control, should be reasonably planned beforehand. However, in our cases, only two patients had undergone resection in the name of an excisional biopsy at previous hospitals, none of which were intended for diagnostic purposes in the first place. As Lans *et al* (24) concluded, initial unplanned treatment for hand sarcomas may not necessarily influence oncologic outcomes, but it must affect the functional or aesthetic qualities, often followed by preventable deficits of the fingers or wrist. In this series, there was no single case in which an R0 margin was confirmed after a previous treatment. Excisional biopsy should be avoided prior to referral to a specialized facility, unless the lesion is clearly identified as an epidermoid cyst or a lipomatous tumour on preoperative imaging.

The prognosis of hand sarcomas was generally good in the present study (5-year OS, 86%), regardless of the site of origin. This result is clearly better than the 78% 5-year OS rate reported in a national epidemiologic study that examined all soft tissue sarcomas of the extremities registered in the U.S. SEER database (25). Exceptionally, none of the five pleomorphic sarcomas with unclassified differentiation achieved disease control, and one patient died due to disease. This outcome appears to be even worse than other specific histological subtypes of high-grade malignancy, such as epithelioid sarcoma, which is characterized by a poor prognosis of <70% for 5-year survival (26). There were few cases of metastasis in this study, which provided a major contribution to the overall fair prognosis.

One of the primary limitations of the present study was its small sample size, as sufficient differences with statistical significance were found to reinforce our discussion. This is not only because the study design was retrospective and single-institutional but also because of the extraordinary rarity of hand sarcoma, where a nationwide overview of hand sarcomas is strongly required in the future. To account for a potential case selection bias, which may skew the results, multi-institutional studies and prospective case collection are urgently needed. Another major limitation is that, because of the general lack of related data, we could not obtain any functional scores, such as the MSTS or Michigan scores. Because reconstruction methods should be evaluated and optimized in consideration of functional prognosis, systematic score recording is also an urgent issue.

In conclusion, the present study reviewed 24 cases of hand sarcoma reported in our institute between 2010-2022, highlighting the clinical differences between finger and PD occurrence. Finger sarcomas are prone to be managed with amputation and followed up without any adjuvant therapies, while PD patients are inclined to undergo multidisciplinary treatment, such as reconstructive procedures or adjuvant chemotherapy. The PD group included all seven synovial sarcomas and no bone sarcomas. Compared to the occurrence of PD, finger sarcomas had a slight tendency to provoke pain. Hand sarcomas were generally characterized by a fair prognosis and metastasis-free condition, except for pleomorphic sarcomas with unclassified differentiation.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

EK, SI, KO, SO, SF and AK were the case providers who performed diagnosis and treatment for the cases analyzed in this study. SM conducted the review of these cases. SM and YT performed the statistical analyses. EK, SI, KO, SO, SF and AK confirmed the authenticity of all the raw data. The first draft of the manuscript was written by SM and EK, and all the authors commented on the previous versions of the manuscript. SM, EK, YT, SI, KO, SO, SF and AK have read and approved the final version of the manuscript.

Ethics approval and consent to participate

This study was conducted in accordance with the 1964 Declaration of Helsinki and its subsequent amendments. The study protocol was approved by our National Cancer Centre Institutional Review Board (IRB no. 2017-336). The collected data were anonymized to ensure patient privacy and non-identifiability. As per our institutional standards, formal patient consent was not required for this type of study.

Patient consent for publication

Patient consent was covered under ethical blanket consent (IRB no. 2017-336).

Competing interests

The authors declare that they have no competing interests.

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