Extra-Axial Chordoma of the Hand

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Chordomas are low-grade malignant tumors that are locally aggressive and have the potential to metastasize. They most often occur in the sacrococcygeal and spheno-occipital portions of the vertebral column. Morphologically similar tumors have been found outside the axial skeleton and are referred to as extra-axial chordomas. Several case reports have described the radiologic, microscopic, and immunologic profiles of these tumors and their similarities to axial chordomas. The authors report a 24-year-old man who presented with a mass in his left hand and underwent surgical excision. Specimens stained positive for pancytokeratin, S100, and brachyury. Brachyury is a protein that is present during embryogenesis and is expressed by chordomas. This is the first report of an extra-axial chordoma within the interosseous muscle compartment of the hand in a young patient. *(J Hand Surg Am. 2017;42(11):933.e1-e5.*

Key words Brachyury, extra-axial chordoma, hand tumors.

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THE NOTOCHORD IS IMPORTANT FOR developing a blueprint for paraxial mesoderm and the neural tube during embryogenesis. The gene brachyury, which is critical for notochord differentiation and posterior mesoderm formation in vertebrate embryos, is expressed by the primordial mesoderm and later in the notochord.[1] Recently, the brachyury protein has been found to be a consistent marker for identifying tumors that possess notochord tissue, which include axial and extra-axial chordomas (EACs).[2,3] This novel marker helps distinguish true chordoma tumors from parachordomas and myoepithelial tumors.

Historically, any tumor that was morphologically like chordomas and stained positive for cytokeratin, epithelial membrane antigen and S100, was referred to as a parachordoma, a term coined by Maria Dabska in 1977.[4] However, more recent studies[3,5,6] advocate the pairing of parachordomas with myoepitheliomas and axial chordomas with EACs. These new groupings have been proposed because of disparities in immunohistochemical staining and clinical behavior between the 2 groups.

The term EAC has gained popularity to distinguish this tumor from parachordomas. The key to differentiating between the 2 is brachyury. It is considered a specific marker because more than 90% of chordomas stain positive for brachyury. Brachyury-negative chordoma-like tumors have de-differentiated or are considered parachordomas.[2] Tirabosco et al[3] showed that 10 of 12 EACs were brachyury positive, and the other 2 were likely parachordomas. To date, the only tumors other than chordomas known to express brachyury are hemangioblastomas of the central nervous system and testicular germ cell tumors.[3] These tumors are not typically found in the periphery, thus making brachyury a powerful tool for diagnosing EACs when chordoma-like masses are found in the appendicular skeleton or soft tissues. The case describes a young, healthy patient with an EAC of the left hand.

CASE REPORT

This report adheres to the Strengthening the Reporting of Observational Studies in Epidemiology

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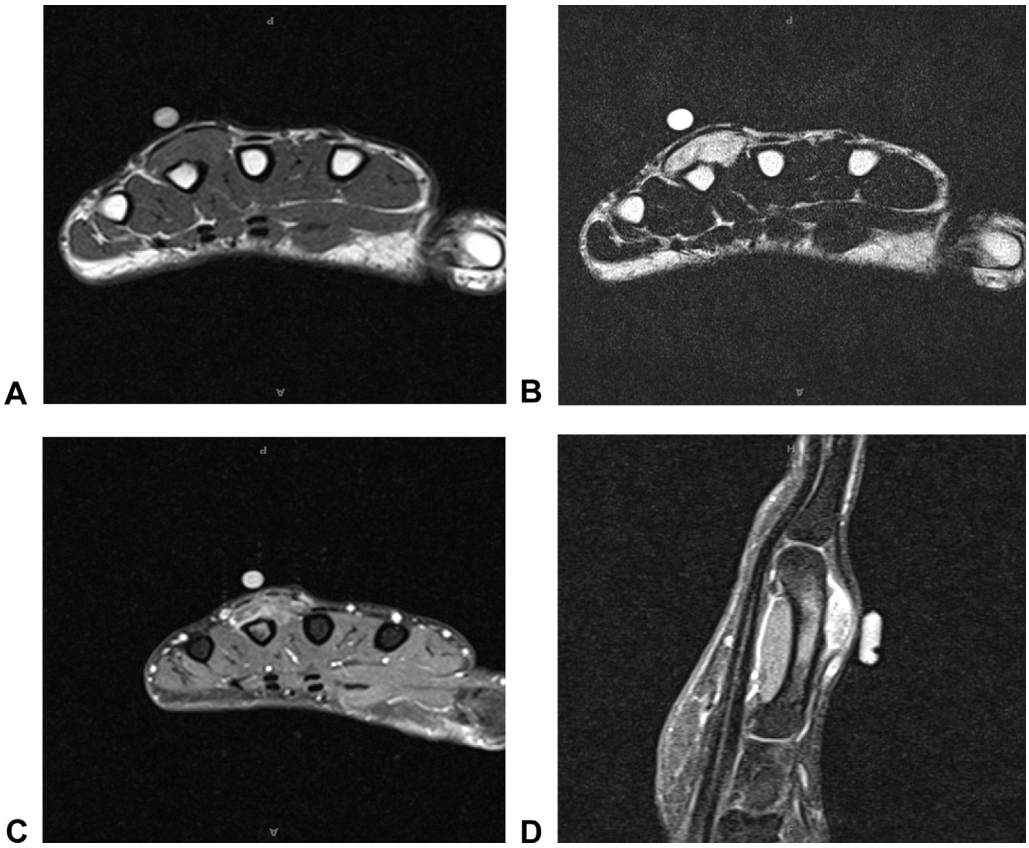

FIGURE 1: Magnetic resonance images of the left hand of a 24-year-old man. **A** T1-weighted axial image showing a mass located on the dorsum of the hand abutting the fourth metacarpal. **B** T2-weighted axial image. **C** Contrast-enhanced T2-weighted axial image showing heterogeneous central enhancement of the mass. **D** Contrast-enhanced T2-weighted sagittal image. Note the increased signal in the metacarpal marrow space.

guidelines, and the patient provided informed consent for publication of the case.

A healthy 24-year-old man presented for evaluation of a slow-growing mass of 7 years' duration, on his left hand. The patient denied any inciting trauma to his hand. The mass was initially asymptomatic but had become painful with activity during the last year. The patient had slowly begun to lose extension of his fourth digit during this same period. Physical examination revealed an ill-defined mass between the third and fourth metacarpals that was fixed and nontender to palpation. The skin appeared normal. Magnetic resonance imaging (MRI) was performed and was sufficient for preoperative planning; no radiographs were taken. MRI revealed a 1.1 cm × 2.2 cm × 2.7 cm lobulated, soft-tissue mass at the level of the distal aspect of the third and fourth metacarpals immediately deep to the extensor tendons (Fig. 1). The mass was isointense to skeletal muscle on T1-weighted MRI and hyperintense to surrounding tissues on T2-weighted MRI, with very little heterogeneity. The mass enhanced after gadolinium administration. There were no fluid-fluid levels present. There appeared to be osseous involvement, given the presence of bone marrow edema in the distal diaphysis of the fourth metacarpal and as evidenced by possible cortical erosion. The bone marrow edema appeared reactive and likely secondary to expansion of the mass against the bone. Most of the tumor was extraosseous and was felt to originate from the soft tissue rather than bone because, given its size and insidious growth, the intramedullary canal and contralateral cortex would have been affected if it originated within bone. Additionally, the tumor capsule appeared to be stuck down to the periosteum and cortical bone, hinting at tumor expansion within the soft tissue.

Open biopsy showed a firm, fixed, hypervascular, pink, and tan mass. Microscopically, the tumor tissue contained small ovoid cells and large cells with multiple vacuoles in the cytoplasm arranged in cords embedded within an abundant myxoid extracellular matrix. The larger cells were physaliferous cells, which are pathognomonic for chordomas (Fig. 2).

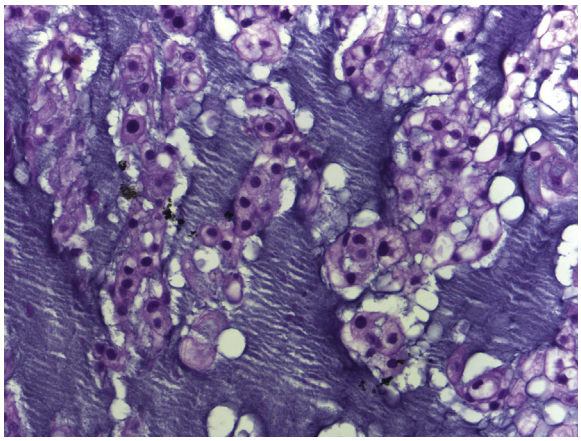

FIGURE 2: Hematoxylin and eosin stain of extra-axial chordoma showing physaliferous cells and ovoid cells distributed in cords within an extracellular matrix.

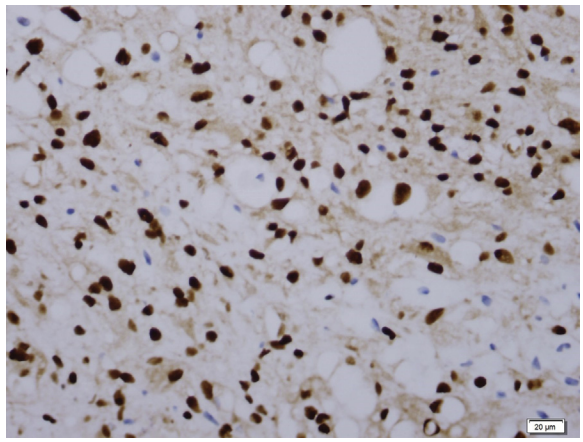

FIGURE 3: Positive brachyury stain confirming the diagnosis of extra-axial chordoma.

Positive stains were brachyury, broad-spectrum keratin, and S100, confirming the diagnosis of EAC (Fig. 3). A staging chest computed tomography scan was negative for metastatic disease. A whole-spine MRI was performed to rule out the possibility of a primary axial chordoma with metastasis to the soft tissue. The MRI was normal, without evidence of a mass. The patient returned 3 weeks after open biopsy for definitive surgical treatment. Surgical planes and cuts were planned according to the known biopsy tract, preoperative imaging, and intraoperative assessment of healthy versus involved tissue. Surgical treatment included wide excision of the mass *en bloc* with the biopsy tract and partial metacarpal diaphysectomy. The diaphysectomy consisted of removing the portion of the mass adherent to the bone, along with visibly uninvolved cortical bone, by using a bone scalpel to resect 70% of the length and 50% of the depth of the ulnar cortex of the fourth metacarpal. The amount of bone resected can be appreciated on radiographs performed 2 weeks postoperatively (Fig. 4). There was adequate bone stock remaining after resection, and bony reconstruction was considered to be unnecessary. Ring finger extensor digitorum communis repair was performed with a gracilis allograft in a modified Kessler fashion. The dorsal ulnar sensory nerve was reconstructed using a nerve allograft secured to the remaining proximal and distal nerve stumps (Fig. 5).

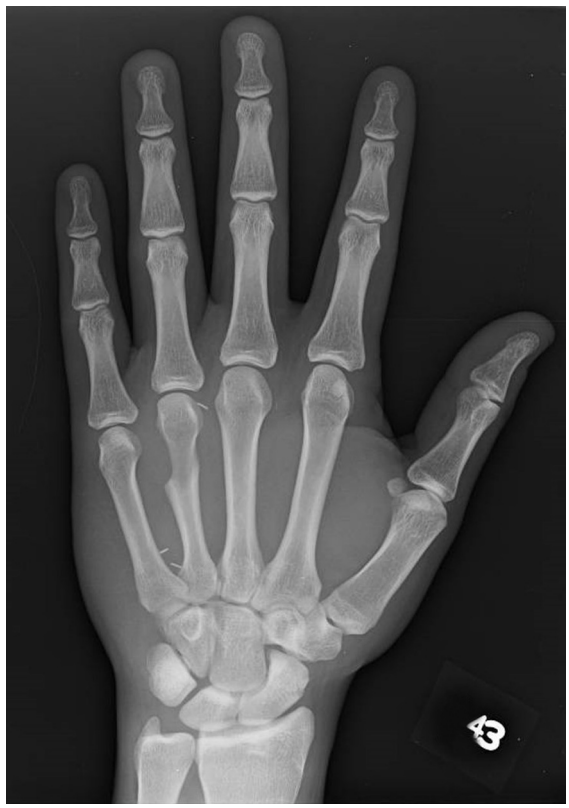

FIGURE 4: Anteroposterior radiograph of the left hand 2 weeks postoperatively showing residual distal one-third cortical defect along the ulnar aspect of the fourth metacarpal secondary to operative resection.

Pathology examination revealed a 1.5 cm × 1 cm pearly white, encapsulated nodule adherent to the underlying bone. The specimen was serially sectioned, revealing that the tumor was intimately attached to the bone. No intramedullary neoplasm was found. The margins of resection were negative for tumor. Postoperatively, the patient initially had mild numbness along the ulnar border of the fourth

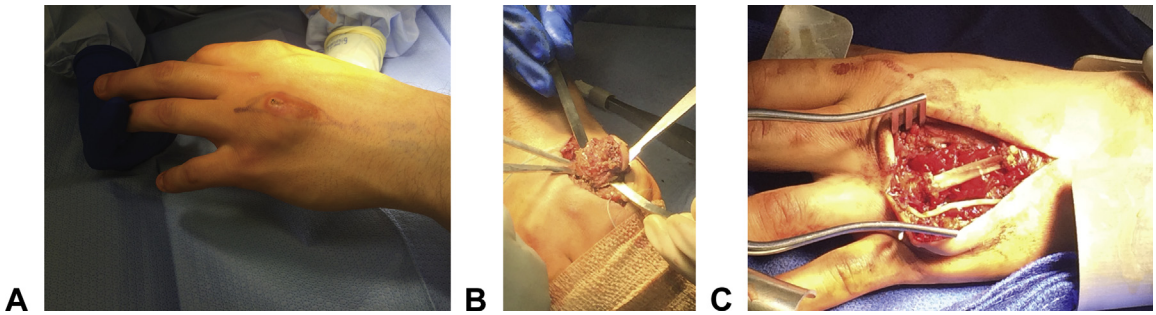

FIGURE 5: A Preoperative view showing a prominent mass between the third and fourth metacarpals on the dorsal left hand of a 24-year-old man. Note the flexed posture of the fourth finger. **B** Intraoperative view of the wide excision of the mass. Osteotomes have been placed proximal and distal to the mass to complete the hemidiaphysectomy. **C** The tumor resection bed showing the remaining fourth metacarpal.

TABLE 1. Case Reports of Brachyury-Positive Extra-Axial Soft-Tissue Chordomas

Study	Patient Age (y)	Tumor Site	Staining	Microscopic Morphology	Treatment
Tirabosco et al[3] 2008	66	Dorsum thumb; juxta-articular	CK19, S100, pancytokeratin	Tumor cells formed cords and clusters and had eosinophilic to amphophilic cytoplasm; vacuolation present; absent necrosis	Wide resection
	44	Wrist; juxta-articular			
Suzuki et al[8] 2011	87	Right wrist and hand; along the flexor digitorum and flexor pollicis longus tendon	Cytokeratin19, AE1/AE3, Cam5.2, vimentin, S100, p63, epithelial membrane antigen	Abundant myxoid stroma; epithelioid and fusiform cells with eosinophilic cytoplasm arranged in cords and nests, mild-to-moderate atypia; vacuolated cells present; absent necrosis	Incisional biopsy followed by forearm resection
Current case	24	Dorsum hand; interdigitated between the third and fourth metacarpals	Broad-spectrum keratin, S100	Physaliferous cells along with ovoid cells aligned in cords within a myxoid stroma	Incisional biopsy followed by wide excision

digit of his left hand and a 15° to 25° extensor lag. Now, more than 1 year after surgery, he has full extension and sensation. The patient is being monitored with alternating radiographs and MRI of the left hand and computed tomography of the chest every 6 months.

DISCUSSION

EACs are extremely rare as they are a subcategory of the already rare chordoma, which has an incidence of 0.08/100,000.[7] In addition, brachyury-positive EACs appear to be more commonly found in bone than in soft tissues, and in older individuals, based on reported cases. The 3 brachyury-positive soft-tissue EACs that have been reported were found juxta-articular in the wrist and hand and within the tendon sheath of the thumb.[3,8] The EAC presented in this case appeared to originate from within the interosseous muscle compartment and to extend superficially toward the aponeurosis and deep toward the bone. The patient was younger (24 years) than the patients in whom brachyury-positive soft-tissue EACs have previously been reported (ages 44, 66, and 87 years).

All documented brachyury-positive soft tissue EACs have appeared in the hand. This contrasts with skeletal EACs, which appear in different bones of the appendicular skeleton in both the upper and lower extremities. Van Akkooi et al[9] believed that EACs always appear near osseous and tenosynovial structures, and all documented cases to date, including ours, support this theory. It is important for hand surgeons to recognize the shared features of brachyury-positive soft-tissue EACs, which may help them interpret diagnostic studies and determine appropriate treatment (Table 1).

Chordomas of the axial skeleton are slow-growing and locally aggressive tumors with high rates of recurrence given that complete resection is often difficult. They are typically found around the sacrococcygeal region of the spine, where wide tumor resections are associated with high morbidity because of the proximity of vital structures around the spine. Boriani et al[10] reported recurrence rates of 75% to 100% in patients who underwent intralesional or extracapsular excision and 50% in patients treated with *en bloc* excisions but inadequate margins. Similar outcomes occur when EACs are treated with intralesional or marginal excisions. The first 3 documented cases of recurrence were in patients treated with curettage or marginal excision. No recurrences were documented in those treated with wide excision.[3] A more recent study reported the fourth and fifth documented recurrences of EACs after patients were treated with excisional biopsy and curettage with bone grafting.[11] These findings suggest that EACs behave similarly to their axial counterparts, for which the recurrence rate is high when the tumors are treated with marginal or intralesional excision and likely low when treated with wide excision given the absence of reported recurrences.

No consensus has been reached regarding the use of adjuvant radiotherapy for treating soft-tissue EACs. This treatment approach differs from that applied for parachordomas, which are less aggressive, recur less frequently, and have not been found to metastasize.[6] Therefore, it is important to differentiate between EACs and parachordomas because the diagnosis will dictate surgical management. Our patient did not receive adjuvant radiation given the lack of efficacy in a tumor measuring less than 5 cm with negative margins and the associated morbidity in radiated hands.[12]

Currently, the limited data suggest that EACs should be treated with wide excision with or without adjuvant radiation. More cases of brachyury-positive soft-tissue EACs will need to be reported to determine the natural history of this rare tumor and which management options provide the best outcomes.

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