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## Oncology

# Myopericytoma/myopericytomatosis of the lower extremity in two young patients: a recently designated rare soft tissue neoplasm

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### ABSTRACT

Myopericytomas are rare, slow-growing benign perivascular tumors most commonly arising within the superficial subcutaneous soft tissues of the lower extremity. They represent one of several related perivascular tumors of myoid lineage with similar morphology and shared immunohistochemical profile including positive staining for smooth muscle actin. Histologically, myopericytoma exhibit concentric, perivascular proliferation of spindled myoid cells with bland elongated nuclei and associated blood vessels. A solitary well-demarcated nodule or mass is typically referred to as myopericytoma, whereas an infiltrative multinodular lesion has more recently been termed myopericytomatosis. At magnetic resonance imaging, tumors are most commonly superficial, may be well-defined (myopericytoma) or ill-defined (myopericytomatosis), and demonstrate highly vascularized, avidly enhancing soft tissue often with areas of internal hemorrhage. We report 2 cases involving the lower extremity (1 myopericytoma and 1 myopericytomatosis) occurring in young patients, focusing on the clinical, histopathologic, and radiologic characteristics of this relatively new distinct entity.

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## Introduction

Myopericytoma is an uncommon, benign soft tissue neoplasm that arises from perivascular smooth muscle-like myoid cells that share features of both glomus and smooth muscle

cells [1]. Myopericytomas are histologically characterized by concentric, perivascular growth of spindled myoid cells and are considered within a morphological spectrum of disease, which includes myofibroma, infantile hemangiopericytoma, angioleiomyoma, and glomus tumor. All demonstrate a perivascular myoid lineage and are categorized as perivascular

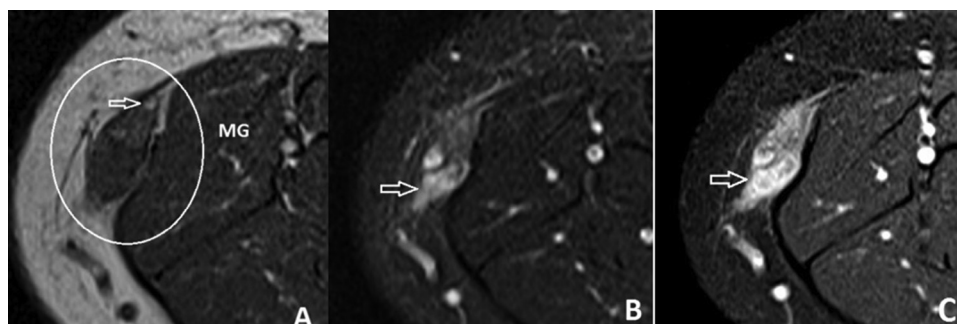
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**Fig. 1** – Seventeen-year-old male with left calf mass. (A) Axial T1-weighted turbo spin echo image demonstrates a small, superficial, irregular, and heterogeneous soft tissue mass (circle) overlying the medial head of the gastrocnemius muscle (MG) with suggestion of internal hemorrhage (arrow). (B) Axial short tau inversion recovery demonstrates a multinodular, markedly hyperintense area of soft tissue (arrow). (C) Gadolinium-enhanced T1-weighted fat-suppressed 3-dimensional gradient echo image demonstrates avid contrast enhancement of the multinodular soft tissue seen in B (arrow).

(pericytic) tumors in the 2013 World Health Organization Tumors of Soft Tissue and Bone [2]. There are limited reports in the existing literature describing the imaging appearance of myopericytoma likely as a result of prior categorization of these tumors as hemangiopericytoma. Most published data have focused on the clinical and histopathologic features of this entity. The cases presented herein represent examples of myopericytoma and myopericytomatosis in an effort to advance the available information on the imaging characteristics of this rare, recently designated perivascular soft tissue neoplasm.

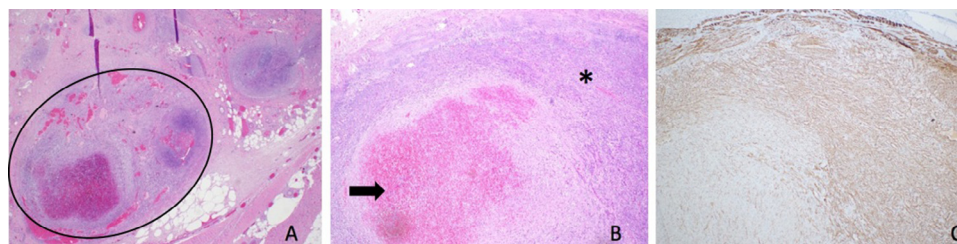
### Case 1

A 17-year-old male presented with a chief complaint of a medial left leg mass. He reported that the mass had been present for several months and denied any recent increase in size or preceding trauma. He reported that the mass was painful only when touched and denied any radiating symptoms or color changes of the overlying skin. He had no pertinent medical history, no history of prior surgery, and no pertinent family history of cancer. On physical examination, the mass was soft, somewhat fixed with no overlying skin changes, and only mildly tender to palpation.

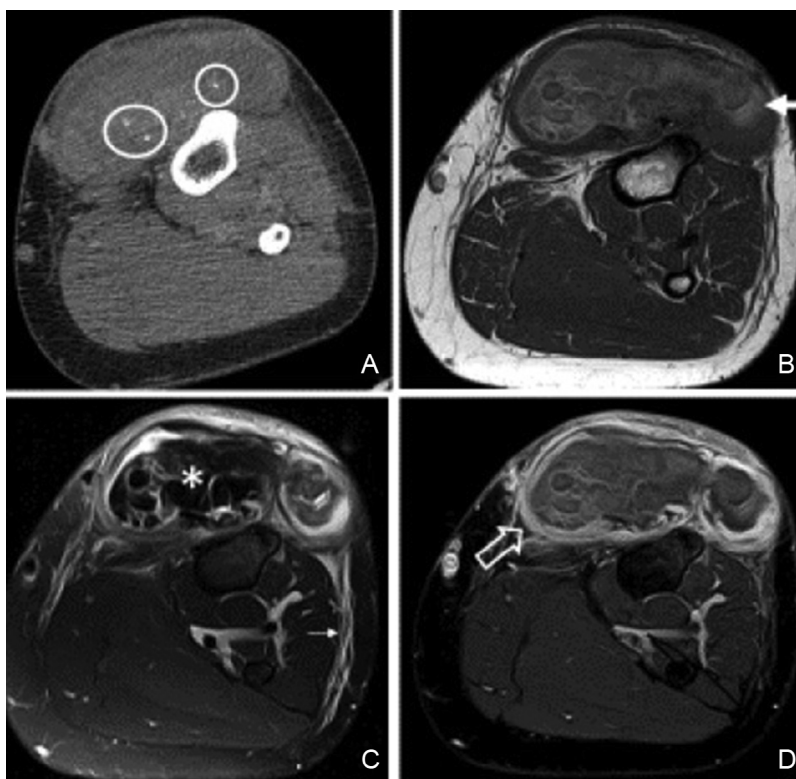
At diagnostic imaging, orthogonal radiographs of the leg were unremarkable. Unenhanced and gadolinium-enhanced

magnetic resonance imaging (MRI) of the left leg was performed. MRI revealed a superficial ill-defined infiltrative appearing soft tissue mass measuring  $3.4 \times 1.7 \times 0.9$  cm abutting the investing fascia of the underlying compartmental musculature. The mass demonstrated internal heterogeneity including foci of T1-hyperintense signal suggestive of internal hemorrhage (vs fat), markedly T2-hyperintense soft tissue elements with avid enhancement on contrast-enhanced fat-suppressed T1-weighted imaging, and mild T2-hyperintense peritumoral edema (Fig. 1A-C).

Based on patient age, imaging appearance, and location of the mass, differential diagnostic considerations included synovial sarcoma and therefore a decision was made to proceed with a core-needle biopsy. The biopsy demonstrated highly vascularized soft tissue with a portion of an associated blood vessel wall and fibro-adipose tissue, but no evidence of increased mitosis, cellular atypia, or pleomorphism to suggest malignancy. The case was reviewed at the Sarcoma Multidisciplinary Tumor Board with recommendation for resection. A marginal resection of the mass including a portion of the underlying fascia was performed without immediate complication. Grossly, the mass was ill-defined and indurated with gray-tan color measuring  $4.5 \times 3.5 \times 2.5$  cm. Histologic sections revealed a partially solid mass with multiple nodules of perivascular spindle cell proliferation and a large central blood vessel containing an organizing thrombus with prominent myxoid stroma (Fig. 2A-B). The spindle cells had elongated bland-appearing nuclei with



**Fig. 2** – Myopericytomatosis. (A) A lesion (circle) showing nodules of a perivascular spindle proliferation with centrally located vessels containing organizing thrombus; some nodules appear more solid (hematoxylin-eosin [H&E] 4 $\times$ ). (B) Spindle cells of bland morphology (\*) adjacent to organizing thrombus (arrow) (H&E 10 $\times$ ). (C) Spindle cells show positivity for smooth muscle actin (immunohistochemistry [IHC], 10 $\times$ ).



**Fig. 3** – Twenty-two-year-old man with large anterior left leg mass. (A) Axial contrast-enhanced computed tomography demonstrates a large, superficial, heterogeneous pretibial soft tissue mass with foci of mineralization (circles). (B) Axial T1-weighted turbo spin echo image with hyperintense internal hemorrhage (thick arrow). (C) Axial short tau inversion recovery with hypointense blood products (\*) and peritumoral edema (thin arrow). (D) Gadolinium-enhanced T1-weighted fat-suppressed 3-dimensional gradient echo image with avidly enhancing thick rim of viable soft tissue (open arrow).

pale eosinophilic cytoplasm. Again, there was no atypia or pleomorphism. The spindle cells were diffusely positive for smooth muscle actin (SMA) and focally positive for Desmin (Fig. 2C). Pan-cytokeratin, CD31, CD34, HHV8, caldesmon, and S100 were negative. Given infiltrative margins and multinodular appearance, a final histologic diagnosis of myopericytoma (as opposed to a well-defined, solitary myopericytoma) was rendered.

The patient tolerated the procedure well and was discharged home in good condition following surgery. However, he did develop minor wound drainage and a superficial wound dehiscence, which was treated with local wound care; he had no other complications. As of his most recent postoperative examination 2 months following surgery, the patient had no evidence of local recurrence, denied any pain, and stated that the wound was slowly healing.

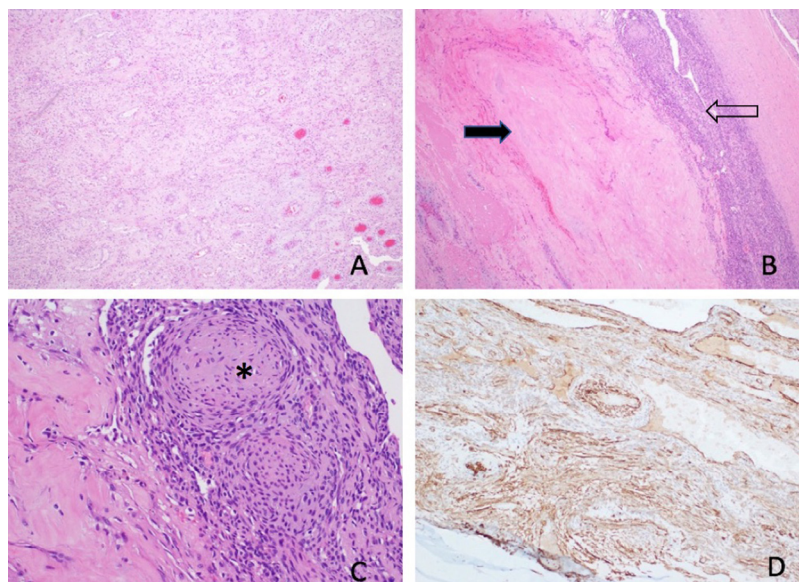
## Case 2

A 22-year-old man with a history of left-sided hemi-hypertrophy presented to a local emergency room for evaluation of an anterior left leg mass just beyond the knee. The patient reported that the mass had been present for at least 6 years, had not changed in size, and had been previously asymptomatic.

However, a few weeks prior, he had visited Vietnam and upon return to the United States, he began experiencing pain, warmth, and redness around the mass. He was admitted to the local hospital with a fever, and imaging studies were performed raising concern for a possible soft tissue sarcoma with superimposed cellulitis. He was started on intravenous antibiotics and reportedly the fever and pain subsided. He was discharged on oral antibiotics and referred to our tertiary cancer center. On physical examination, a soft tissue mass measuring approximately 12 × 10 cm was identified anterior to the proximal tibia. The mass was superficial, soft, and mobile. The overlying skin was erythematous and there was a central pustule without drainage. The mass was exquisitely tender to palpation. The patient had full range of motion of the knee without pain or signs of a joint effusion.

At diagnostic imaging, orthogonal radiographs demonstrated a radio-dense soft tissue mass without definite evidence of mineralization; however, punctate foci of internal calcification were noted on computed tomography. Unenhanced and gadolinium-enhanced MRI demonstrated a large, well-defined subcutaneous pretibial soft tissue mass measuring 12 × 9 × 5.5 cm superficial to the underlying compartmental fascia. The mass showed internal heterogeneity including evidence of acute and chronic hemorrhage or blood products and a thick peripheral rim of avidly enhancing soft tissue with peritumoral edema (Fig. 3A-D).





**Fig. 4 – Myopericytoma.** (A) A lesion showing numerous blood vessels with perivascular spindle cell proliferation concentrically arranged (hematoxylin-eosin [H&E] 2 $\times$ ). (B) Peripheral proliferation of spindle cells (open arrow) adjacent to large area of hyalinization and fibrin (arrow) (H&E 4 $\times$ ). (C) Bland spindle cells with eosinophilic cytoplasm arranged around vessels in a concentric pattern (\*) adjacent to hyalinized tissue (H&E 20 $\times$ ). (D) Spindle cells show positivity for smooth muscle actin (Immunohistochemistry [IHC] 10 $\times$ ).

He continued on oral antibiotics for cellulitis; however, the pustule became larger and began draining. At this point, given prolonged history pointing to a benign entity and following discussion in the Sarcoma Multidisciplinary Tumor Board, a decision was made to undergo an excisional biopsy. The surgical specimen consisted of a 12.5  $\times$  10  $\times$  5 cm ovoid, rubbery encapsulated soft tissue mass. Cut surfaces revealed predominantly necrotic and hemorrhagic tissue (more than 90%) adjacent to soft, rubbery pink-tan tissue. Histologic examination revealed a well-circumscribed, encapsulated mass with large areas of hemorrhage and necrosis as well as hyalinization and infarction. Areas of residual viable soft tissue revealed a spindle cell proliferation of bland appearance arranged concentrically around blood vessels (Fig. 4A-C). There was no atypia or pleomorphism. The spindle cells were diffusely positive for SMA (Fig. 4D). Pan-cytokeratin, S100, SOX10, CD34, CD31, Desmin, caldesmon, CD68, and CD163 were negative. A diagnosis of myopericytoma with florid superimposed reactive alterations was rendered.

The patient had an uncomplicated postoperative course. His wound healed well and he was soon ambulating without difficulty. As of his most recent follow-up examination 2 months following surgery, the patient had no evidence of local tumor recurrence or any complaints, denying any new mass or pain.

## Discussion

Myopericytoma is a rare, recently designated, benign perivascular soft tissue neoplasm representing one of several tumors comprising a spectrum of diseases, which share a

perivascular pattern of growth and certain histopathologic features. Myopericytoma has only been recognized as a separate entity in the past 2 decades [2,3]. This disease may affect patients of any age. However, it most commonly occurs in young patients within the superficial soft tissues of the lower extremity. Deep-seated, visceral, and intracranial sites of disease are extremely rare [2,4–9]. Clinically, myopericytoma most often presents as a solitary, well-demarcated, slow-growing, and non-painful palpable nodule or soft tissue mass present for several years [3,4,10]. Alternatively, less common cases of multiple small clustered nodules histologically appearing as numerous discrete perivascular nodules infiltrating the dermal or subcutaneous tissues have been termed myopericytomatosis by Fletcher and colleagues [11]. Most have an excellent prognosis following complete surgical resection, but local tumor recurrence may occur with incomplete resection [2]. There is currently no recommended role for the administration of chemotherapy or radiotherapy. Although very rare, malignant myopericytoma has been reported. These are typically deep-seated and infiltrative tumors with nuclear pleomorphism, brisk mitotic activity, and internal necrosis [4,12–14]. They are associated with an aggressive clinical course and often distant metastatic disease [14,15].

Our examples of myopericytoma and myopericytomatosis both occurred in young males and involved the superficial soft tissues of the lower extremity. As with most musculoskeletal tumors, patient age and location contribute to the differential diagnosis, which includes synovial sarcoma. Both myopericytoma and synovial sarcoma are most common in young patients, demonstrate avid enhancement of soft tissue elements and often exhibit internal hemorrhage, and may demonstrate mineralization. Further, tumor size and the presence

of peritumoral edema are not discriminating features. As seen in our cases, there is marked variability in size with one measuring 4.5 cm in greatest dimension and the other measuring 12.5 cm, felt secondary to marked internal hemorrhage and necrosis. However at histopathology, both tumors similarly demonstrated highly vascularized soft tissue with a concentric pattern of bland-appearing perivascular spindle cell proliferation, numerous variably sized associated blood vessels, and diffuse staining for SMA. Although rare, the larger tumor did also reveal areas of hyalinization and coagulative ischemic necrosis possibly because of outgrowth of blood supply [4].

At diagnostic imaging, most reports of myopericytoma describe a well-defined hypervascular solid soft tissue mass with diffuse avid homogenous intravenous contrast enhancement, whereas others describe internal hemorrhage and heterogeneity with incomplete contrast enhancement and occasionally dystrophic calcification [16,17]. Vascular flow voids may or may not be evident at MRI. Our 2 examples demonstrate several similar and other contrasting imaging characteristics. Both occurred in the distal lower extremity and were located superficial to the investing fascia of the underlying compartmental musculature within the subcutaneous soft tissues. Both demonstrated internal heterogeneity including T1-hyperintense signal confirmed to represent internal hemorrhage. Both demonstrated markedly T2-hyperintense soft tissue elements with corresponding avid enhancement on gadolinium-enhanced T1-weighted images confirmed to represent highly vascularized tissue, including much of the smaller tumor and a thick peripheral rim of tissue within the larger mass, and varying degrees of peritumoral edema. In contrast, whereas the small mass was irregular and ill-defined with an infiltrative appearance (myopericytomatosis), the large mass was well defined with distinct margins (myopericytoma). Finally, note is made of foci of dystrophic mineralization within the larger mass on computed tomography.

As mentioned above, the spectrum of perivascular tumors, which includes myopericytoma, shares a specific immunohistochemical profile including expression of alpha smooth muscle actin ( $\alpha$ SMA), muscle-specific actin, h-caldesmon, CD146, platelet-derived growth factor receptor beta-subunit (PDGFR $\beta$ ), and regulator of G-protein signaling 5 [18,19]. Recently, Shrestha et al. reported consistent absence of angiopoietin-1 (Ang-1), but uniform expression of angiopoietin-2 (Ang-2) in perivascular soft tissue tumors, with some variation in expression between histologic subtypes [20]. Furthermore, in a small case series, molecular analysis using targeted next-generation sequencing was used to analyze conventional myopericytoma and myopericytomatosis cases, which reportedly identified recurrent PDGFR $\beta$  mutations in 4 of 5 cases of myopericytomatosis and 3 of 5 myopericytomas [11]. As mutations in PDGFR $\beta$  have been described in familial infantile myofibromatosis, these findings support the belief that myopericytoma and myopericytomatosis reside within the same biologic spectrum as infantile myofibromatosis and other perivascular tumors [21,22].

In conclusion, limited literature exists on myopericytomas because of rarity of disease and recent distinction within a group of tumors formerly classified as hemangiopericytomas. The 2 cases presented herein involve young males with lower

extremity masses exhibiting several common imaging and histopathologic features. Both were treated with complete surgical resection and, to date, remain without evidence of local recurrence or distant disease over a short postoperative period.

#### REFERENCES

- Dray MS, McCarthy SW, Palmer AA, Bonar SF, Stalley PD, Marjoniemi V, et al. Myopericytoma: a unifying term for a spectrum of tumours that show overlapping features with myofibroma. A review of 14 cases. *J Clin Pathol* 2006;59(1):67–73. [Epub 2006/01/06]. PMID: 16394283. Pubmed Central PMCID: PMC1860256. eng.
- Fletcher CDM. World Health Organization, International Agency for Research on Cancer. WHO classification of tumours of soft tissue and bone. 4th ed. Lyon: IARC Press; 2013. 468 p. p.
- Granter SR, Badizadegan K, Fletcher CD. Myofibromatosis in adults, glomangiopericytoma, and myopericytoma: a spectrum of tumors showing perivascular myoid differentiation. *Am J Surg Pathol* 1998;22(5):513–25. [Epub 1998/05/20]. PMID: 9591720. eng.
- Mentzel T, Dei Tos AP, Sapi Z, Kutzner H. Myopericytoma of skin and soft tissues: clinicopathologic and immunohistochemical study of 54 cases. *Am J Surg Pathol* 2006;30(1):104–13. [Epub 2005/12/07]. PMID: 16330949. eng.
- Datta V, Rawal YB, Mincer HH, Anderson MK. Myopericytoma of the oral cavity. *Head Neck* 2007;29(6):605–8. [Epub 2007/01/26]. PMID: 17252599. eng.
- Nagai T, Kamimura T, Itou K, Fujii M, Tsukino H, Mukai S, et al. Myopericytoma in urinary bladder: a case report. *J Med Case Rep* 2017;11(1):46. [Epub 2017/02/20]. PMID: 28214470. Pubmed Central PMCID: PMC5316426. eng.
- Lau SK, Klein R, Jiang Z, Weiss LM, Chu PG. Myopericytoma of the kidney. *Hum Pathol* 2010;41(10):1500–4. [Epub 2010/07/27]. PMID: 20655090. eng.
- Rousseau A, Kujas M, van Effenterre R, Boch AL, Carpentier A, Leroy JP, et al. Primary intracranial myopericytoma: report of three cases and review of the literature. *Neuropathol Appl Neurobiol* 2005;31(6):641–8. [Epub 2005/11/12]. PMID: 16281913. eng.
- Zhang Z, Yu D, Shi H, Xie D. Renal myopericytoma: a case report with a literature review. *Oncol Lett* 2014;7(1):285–7. [Epub 2013/12/19]. PMID: 24348865. Pubmed Central PMCID: PMC3861592. eng.
- Xia L, Chen Y, Geng N, Jiang J, Yang M, Zhang W. Multifocal myopericytoma in the maxillofacial region: a case report. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2010;109(2):e59–62. PMID: 20123399.
- Hung Y, Fletcher CD. Myopericytomatosis: clinicopathologic analysis of a series of 11 cases with molecular identification of recurrent PDGFRB alterations. *Mod Pathol* 2017;30(S2):11–27.
- Li J, Zhao M, Chen Z, Zou L, Teng X. Renal myopericytoma: a clinicopathologic study of six cases and review of the literature. *Int J Clin Exp Pathol* 2015;8(5):4307–20. [Epub 2015/07/21]. PMID: 26191123. Pubmed Central PMCID: PMC4502995. eng.
- Binesh F, Moghadam RN, Shabani M, Mortazavizadeh MR, Zare S. Malignant myopericytoma of shoulder: a rare lesion. *APSP J. Case Rep* 2016;7(3):21. [Epub 2016/07/12]. PMID: 27398322. Pubmed Central PMCID: PMC4921218. eng.
- McMenamin ME, Fletcher CD. Malignant myopericytoma: expanding the spectrum of tumours with myopericytic differentiation. *Histopathology* 2002;41(5):450–60. [Epub 2002/10/31]. PMID: 12405913. eng.

- [15] Patrick A, Soares-de-Almeida L, Heinz K. Malignant myopericytoma: report of a new case and review of the literature. *Am J Dermatopathol* 2016;38(4):307–11. [Epub 2016/02/11]. PMID: 26863056. eng.
- [16] Lee SK, Kwon SY. Gray-scale and power doppler sonography and ct findings of myopericytoma of the posterior cervical space. *AJNR Am J Neuroradiol* 2009;30(8):1604–6. [Epub 2009/03/13]. PMID: 19279277. eng.
- [17] Harish S, O'Donnell P, Briggs TW, Saifuddin A, Flanagan AM. Myopericytoma in Kager's fat pad. *Skeletal Radiol* 2007;36(2):165–9. PMID: 16570177.
- [18] Shen J, Shrestha S, Yen YH, Asatrian G, Mravic M, Soo C, et al. Pericyte antigens in perivascular soft tissue tumors. *Int J Surg Pathol* 2015;23(8):638–48. [Epub 2015/06/19]. PMID: 26085647. Pubmed Central PMCID: PMC4641786. eng.
- [19] Shen J, Shrestha S, Yen YH, Scott MA, Soo C, Ting K, et al. The pericyte antigen RGS5 in perivascular soft tissue tumors. *Hum Pathol* 2016;47(1):121–31. [Epub 2015/11/13]. PMID: 26558691. Pubmed Central PMCID: PMC4861638, eng.
- [20] Shrestha S, Shen J, Giacomelli P, Scott MA, Soo C, Ting K, et al. Ang-2 but not ang-1 expression in perivascular soft tissue tumors. *J Orthop.* 2017;14(1):147–53. [Epub 2016/12/13]. PMID: 27942190. Pubmed Central PMCID: PMC5134090. eng.
- [21] Cheung YH, Gayden T, Campeau PM, LeDuc CA, Russo D, Nguyen VH, et al. A recurrent PDGFRB mutation causes familial infantile myofibromatosis. *Am. J. Hum. Gen.* 2013;92(6):996–1000. PMID: 23731537. Pubmed Central PMCID: 3675240.
- [22] Martignetti JA, Tian L, Li D, Ramirez MC, Camacho-Vanegas O, Camacho SC, et al. Mutations in PDGFRB cause autosomal-dominant infantile myofibromatosis. *Am J Hum Genet* 2013;92(6):1001–7. PMID: 23731542. Pubmed Central PMCID: 3675260.