
GIANT CELL REPARATIVE GRANULOMA OF THE DISTAL PHALANX: A REVIEW OF OSTEOLYTIC LESIONS OF THE PHALANGES AND THEIR RADIOLOGIC DIFFERENTIAL DIAGNOSIS

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Giant cell reparative granuloma (GCRG) is a nonneoplastic lesion that mimics several benign and malignant abnormalities on imaging studies. The diagnosis of GCRG should be considered in the radiologic differential diagnosis of osteolysis of the distal phalanx. Treatment usually involves curettage, which sometimes needs to be repeated. We highlight 3 cases of GCRG of small tubular bones of the hand, 2 involving the distal phalanx of the middle finger and 1 in the middle phalanx. We also review osteolytic lesions of the phalanges. Awareness of the diagnosis of GCRG helps to plan optimal treatment.

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Giant cell reparative granuloma (GCRG) is a nonneoplastic osteolytic lesion of unknown origin that may have an aggressive imaging appearance. GCRG first was described in 1953 by Jaffe¹

and most commonly occurs in the skull, jaw, and facial bones. Tubular bones of the hand and foot are affected less frequently. The involvement of a distal phalanx is unusual and leads to a wide differential diagnosis.

We show the magnetic resonance (MR) appearance of a GCRG. We describe 3 cases of GCRG of small tubular bones of the hand, 2 involving the distal phalanx, and present MR imaging in one. The differential diagnosis of a lucent lesion of the distal phalanx is reviewed and is shown by appropriate cases.

CASE HIGHLIGHTS

Case 1

A 39-year-old man presented with a painless swelling of the palmar side of the distal phalanx of the

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FIGURE 1. Preoperative photograph of the middle finger. Severe swelling and discoloration.

right middle finger (Figure 1). Symptoms had started 3 months before presentation, after bruising the middle finger, followed by progressive tumefaction.

Subcutaneous swelling and hemorrhage were visible at the time of presentation. There was no loss of sensibility and tenderness was minimal. The range of motion, circulation, and muscle strength were within normal limits. General physical examination was normal. There was no adenopathy, pathologic laboratory results, or other findings consistent with a malignancy.

The anteroposterior and lateral radiographs obtained at presentation revealed extensive osteolysis and soft-tissue swelling of the distal phalanx of the middle finger (Figure 2). There was no calcification, new bone formation, or periosteal reaction. MR imaging was performed on a 1.5-T scanner (Symphony; Siemens Medical Solutions, Erlangen, Germany) with a dedicated wrist coil. The following sequences were obtained: T1-weighted spin-echo (recovery time 450 ms, echo time 24 ms), T2-weighted turbo spin-echo (recovery time 4500 ms, echo time 107 ms), short tau inversion recovery (recovery time 4,500 ms, echo time 35 ms), and T1-weighted spin-echo with fat suppression after intravenous injection of Gadolinium (GD-DPTA) (recovery time 609 ms, echo time 24 ms). Slices were obtained in different orientations, between 2- and 4-mm thick. A $1.4 \times 1 \times 1$ cm solid mass with soft-tissue extension was shown with intermediate signal intensity on T1-weighted images, inhomogeneous hyperintensity on T2-weighted images, and

pronounced, slightly irregular enhancement after intravenous injection of gadopentetate (Figure 3).

An incisional biopsy procedure was performed. Histology revealed a cellular lesion consisting of plump spindle cells with groups of multinucleate giant cells and a fibrous stroma with lace-like or trabecular osteoid. Intersecting fibrovascular septa contained prominent sinusoidal vessels, and at times groups of telangiectatic spaces (Figure 4). There was brisk mitotic activity without atypical figures. The lesion extended into the subcutaneous tissues. Pathologic diagnosis was GCRG with soft-tissue extension.

Amputation of the distal phalanx was performed in view of the extensive bone destruction and the lack of normal soft tissue required for covering any surgical defects. Ten months after surgery, the patient is symptom free and there is no evidence of recurrence.

Cases 2 and 3

Our files contain 2 other cases of GCRG with an aneurysmal cystic component, 1 presenting as a sub-



FIGURE 2. Osteolytic lesion of nearly the entire distal phalanx of the middle finger in the dorsovolar (left) and the lateral (right) views.



FIGURE 3. (A) The 1.5-T MR images show a solid mass with soft-tissue extension with intermediate signal intensity on the sagittal T1-weighted images, (B) inhomogeneous hyperintensity on the sagittal T2-weighted image, and (C) pronounced, slightly irregular enhancement after intravenous injection of gadopentetate.

ungual tumor of the distal phalanx of the left middle finger in a 24-year-old man (Figure 5), the other in the middle phalanx of the right middle finger in a 14-year-old girl. Both lesions were cured and follow-up evaluation was unremarkable.

PATHOLOGY

Approximately 70 cases of GCRG occurring in tubular bones of the hand and foot have been reported in the literature.²⁻¹⁸ Thirty-one GCRGs

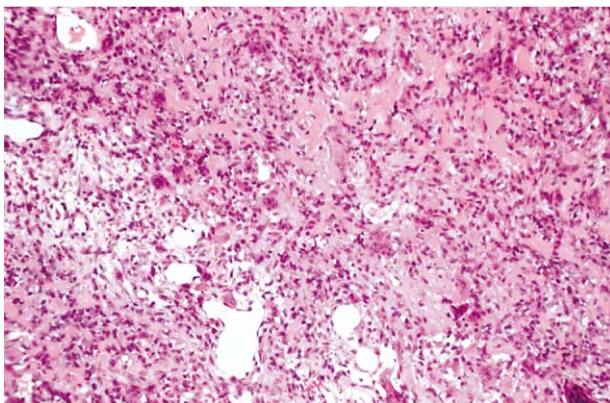


FIGURE 4. Cellular lesion with plump spindle cells and groups of multinucleate giant cells in a fibrous stroma with a lace-like osteoid, intersected by fibrovascular septa with prominent sinusoidal vessels.

(41%) were found in the small bones of the hand as a solitary lesion, although a multicentric form has been described.¹⁹ The pathogenesis of GCRG is debated. Lorenzo and Dorfman¹⁶ believe in a local reparative process associated with traumatic intraosseous hemorrhage. GCRG may develop on top of fibrous dysplasia, enchondromas,²⁰ hyperparathyroidism, rarely Paget's disease, and has been seen in 1 case of Gorlin-Goltz syndrome (nevroid basal cell carcinoma syndrome).²¹ Recently, cytogenetic abnormalities involving a t(X;4)(q22;31.3) translocation were reported in 3 of 13 cultured cells derived from a GCRG of a distal phalanx suggesting clonal abnormalities.²² Translocations involving sex chromosomes and autosomes have been described previously in cases of fibro-osseous lesions, notably involving craniofacial bones.



FIGURE 5. An osteolytic destructive bone lesion in the distal phalanx of a 24-year-old man (case 2). Histology revealed a GCRG with an aneurysmal cystic component.



FIGURE 6. Chondromatous neoplasms. Both the enchondroma (left) and the chondrosarcoma (right) expand the bony shell and erode the inner table. The histologic discrimination between benign and low-grade malignant is problematic.

GCRG is most common in the second and third decades of life but may occur at virtually any age (from childhood to the eighth decade of life).²³ There is no gender predilection. The skull, jaw, and other facial bones are affected most frequently,²⁴ followed by the metacarpals and phalanges of the hands and feet^{6,14,16} where GCRG usually is metaphyseal or diaphyseal in location.^{14,25,26} The distal phalanx rarely is involved.^{5,15}

CLINICAL DIFFERENTIAL DIAGNOSIS

GCRG causes swelling with or without pain, commonly with rapid onset of symptoms, mimicking an aggressive lesion. Laboratory tests are nonconclusive. Brown tumors and solid areas of aneurysmal bone cysts are histopathologically indistinguishable from GCRG.^{16,17,26,27} Brown tumors, however, can be differentiated based on laboratory tests. Giant cell tumors are usually readily distinguishable histologically from GCRG.⁶

RADIOLOGIC DIFFERENTIAL DIAGNOSIS

On imaging, GCRG of the distal phalanx has to be differentiated from a variety of osteolytic lesions.^{5,6,11,19,28-38} The radiographic appearance of GCRG may mimic a giant cell tumor or an aneurysmal bone cyst. Both commonly appear as an

osteolytic lesion with little reactive changes. However, they tend to have a less-aggressive radiographic appearance than in our case and histology usually is able to tell them apart. Chondroblastoma is a rare benign neoplasm of cartilaginous origin that most commonly occurs in the epiphysis or apophysis of long tubular bones. Nevertheless, about 10% are located in the small bones of the hands and feet. Chondroblastoma typically presents as a well-demarcated geographic osteolysis with cortical bulging. The MR appearance characteristically is that of a lobulated hyperintense signal on T2-weighted images and soft-tissue edema. Up to 50% of solitary enchondromas occur in the middle and distal portions of the metacarpals and the proximal portions of the phalanges but rarely in the distal phalanx. They may cause scalloping but they



FIGURE 7. Sharply demarcated osteolytic lesion of an epidermal inclusion cyst.

do not normally cause destruction of cortical bone (Figure 6). They may contain calcifications and have a similar appearance on MR images as chondroblastoma, but without soft-tissue edema. Epithelial inclusion cysts can occur after minor penetrating trauma and may present as an osteolytic lesion (Figure 7). Metastases to the bones of the hand are rare but may occur in carcinoma of the lung (40%), breast (16%), kidney (6%), prostate (3%), and others,^{29,30} and may be found in the distal phalanx (Figure 8). Reactive bone formation and periosteal reaction usually are not seen. Glomus tumors are painful subcutaneous nodules associated with intense, pulsating pain. They originate from outside the bone, which they may erode, are smaller than GCRG, and are highly vascularized with extensive enhancement after intravenous injection of contrast medium.³⁶ Hemangioma and hemangioendothelioma can occur at the fingertips, usually in the nail bed, and usually do not affect bone.³⁷ Sarcoidosis rarely manifests as osteolysis of the middle and distal phalanges. It appears less aggressively radiographically than in our case and periosteal reaction may be present.³⁸ Osteomyelitis rarely involves the short tubular bones of the hand but does have a preference for the distal phalanx (38%). Radiographically, osteomyelitis most commonly presents as an osteolysis (70%). Both laboratory studies and MR findings may help to differentiate it from GCRG.³³

TREATMENT

Curettage often is sufficient. Recurrences are seen, however, in approximately one fourth of patients.¹³ A second curettage or resection is successful in most of these patients. In our presented patient, relatively aggressive surgery was required given the extent of bone destruction and soft-tissue involvement as well as the lack of sufficient healthy tissue to cover the defect.

REFERENCES

1. Jaffe HL. GCRG, traumatic bone cyst and fibrous (fibro-osseous) dysplasia of the bone. *Oral Surg* 1953;6:159-175.
2. Jernstrom P, Stark HH. Giant cell reaction of a metacarpal. *Am J Clin Pathol* 1971;55:77-81.
3. Strasberg Z, Kirkpatrick D, Tuttle RJ. Case report 86. *Skeletal Radiol* 1979;4:47-48.
4. Lingg G, Roessner A, Fiedler V, Lubbesmeyer HJ, Peters PE, Grundmann E. Reparative giant granuloma of the extremi-

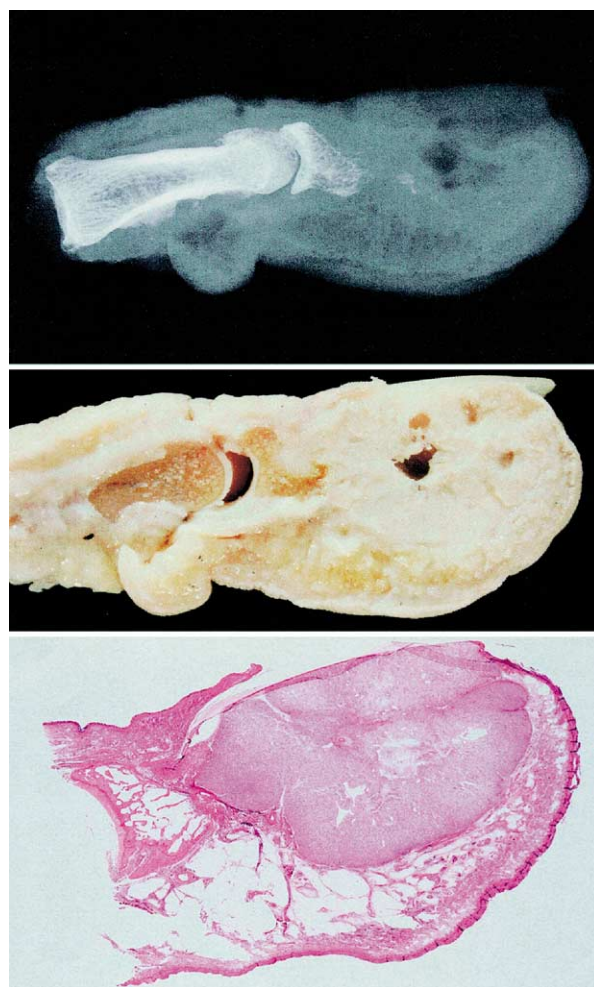


FIGURE 8. Metastasis of a renal cell carcinoma with subtotal destruction of the distal phalanx.

CONCLUSION

Osteolytic lesions of the middle and distal phalanges present a wide spectrum of radiologic differential diagnoses, both benign and malignant. Although rare in occurrence, GCRG should be added to the list of reactive lesions. Given the lack of characteristic findings, MR imaging, rather than affording a more precise diagnosis, assists the planning of surgical treatment.

- ties. *ROFO Fortschr Geb Rontgenstr Nuklearmed* 1985;142:185-188.
5. Picci P, Baldini N, Sudanese A, Boriani S, Campanacci M. Giant cell reparative granuloma and other giant cell lesions of the bones of the hands and feet. *Skeletal Radiol* 1986;15:415-421.
 6. Merkow RL, Bansal M, Inglis AE. Giant cell reparative granuloma in the hand: report of three cases and review of the literature. *J Hand Surg* 1985;10A:733-739.
 7. Giza E, Stern PJ, Cualing H. Aggressive giant reparative granuloma of the metacarpal: a case report. *J Hand Surg* 1997;22A:732-736.
 8. Capozzi JD, Green S, Levy RN, Schwartz IS. Giant cell reaction of small bones. *Clin Orthop* 1987;214:181.
 9. Clarke EP, Pritchett JW. Giant-cell lesion in a sesamoid bone of the thumb. *J Hand Surg* 1998;23B:79-80.
 10. Forouhar FA, Phelan NP, Benton DC. Giant cell reparative granuloma of the small bones of the hands and feet: a report of three cases. *Ann Clin Lab Sci* 2000;30:272-277.
 11. Seemann WR, Genz T, Gospos C, Goth D, Adler CP. Giant-cell reaction of the short tubular bones of the hand and foot. *ROFO Fortschr Geb Rontgenstr Nuklearmed* 1985;142:454-457.
 12. Murphy MD, Nomikos GC, Flemming DJ, Gannon FH, Temple HT, Kransdorf MJ. From archives of AFIP. Imaging of giant cell tumor and giant cell reparative granuloma of bone: radiologic-pathologic correlation. *Radiographics* 2001;21:1283-1309.
 13. Bertoni F, Biscaglia R, Bacchini P. Giant cell reparative granuloma of the phalanx of the hand with aggressive radiographic features. *Skeletal Radiol* 1998;27:584-587.
 14. Ratner V, Dorfmann HD. Giant-cell reparative granuloma of the hand and foot bones. *Clin Orthop* 1990;260:251-258.
 15. Poli G, Di Liddo M, Fruscio A, Verni E, Lollini ME. Giant cell reparative granuloma: presentation of one case and review of the literature. *Chir Organi Mov* 1996;81:217-221.
 16. Lorenzo JC, Dorfman HD. Giant-cell reparative granuloma of the short tubular bones of the hands and feet. *Am J Surg Pathol* 1980;4:551.
 17. D'Alonzo RT, Pitcock JA, Milford LW. Giant-cell reaction of bone. *J Bone Joint Surg* 1972;54A:1267.
 18. Glass TA, Mills SE, Fechner RE, Dyer R, Martin W, Armstrong P. Giant cell reparative granuloma of the hands and feet. *Radiology* 1983;149:165.
 19. Caskey PM, Wolf MD, Fechner RE. Multicentric giant cell reparative granuloma of the small bones of the hand. A case report and review of the literature. *Clin Orthop* 1985;193:199-205.
 20. Oda Y, Iwamoto Y, Ushijima M, Masuda S, Sugioka Y, Tsuneyoshi M. Case report 877: giant cell reparative granuloma arising in enchondromatosis. *Skeletal Radiol* 1994;23:669-671.
 21. Selzer G, Raffaele D, Revach M, Cvibah T, Fried A. Goltz syndrome with multiple giant-cell tumor-like lesions in bones. *Ann Intern Med* 1974;80:714-717.
 22. Buresh CJ, Seemayer TA, Nelson M, Neff JR, Dorfmann HD, Bridge J. t(X;4)(q22;q31.3) in giant cell reparative granuloma. *Cancer Genet Cytogenet* 1999;115:80-81.
 23. Bertoni F, Laus M, Campanacci M. Reazioni a cellule gigantesche dell'osso. *Giorn Ital Ortop Traumatol* 1980;6:235-243.
 24. Waldron CA, Shafer WG. The central giant cell reparative granuloma of the jaws. *Am J Clin Pathol* 1996;45:437-447.
 25. Campanacci M. Tumori dell'osso e delle parti molli. Bologna: Gaggi Ed, 1981:689-692.
 26. Dahlin DC, McLeod RA. Aneurysmal bone cyst and other nonneoplastic conditions. *Skeletal Radiol* 1982;8:243-250.
 27. Yamaguchi T, Dorfmann HD. Giant cell reparative granuloma: a comparative clinicopathologic study of lesions in gnathic and extragnathic sites. *Int J Surg Pathol* 2001;9:189-200.
 28. Wenner MS, Johnson K. Giant cell reparative granuloma of the hand. *J Hand Surg* 1987;12A:1097-1101.
 29. Kumar PP. Metastases of the bones of the hand. *J Natl Med Assoc* 1971;67:275-276.
 30. Martin KA, Dove F. Metastatic carcinomas of the hand. *Hand* 1983;15:343-346.
 31. Galmarini CM, Kertesz A, Oliva R, Porta J, Galmarini FC. Metastasis of bronchogenic carcinoma to the thumb. *Med Oncol* 1998;15:282-285.
 32. Asencio G, Hafdi C, Pujol H, Allieu Y. Osseous metastases in the hand. A general review of three cases. *Ann Chir Main* 1982;1:137-145.
 33. Reilly KE, Linz JC, Stern PJ, Giza E, Wyrick JD. Osteomyelitis of the tubular bones of the hand. *J Hand Surg* 1997;22A:644-649.
 34. Möhrle M, Häfner H. Is subungual melanoma related to trauma? *Dermatology* 2000;204:259-261.
 35. Warso M, Gray T, Gonzalez M. Melanoma of the hand. *J Hand Surg* 1997;22A:354-360.
 36. Theumann NH, Goettman S, Le Viet D, Resnick D, Chung CB, Bittoun J. Recurrent glomus tumor of fingertips: MR imaging evaluation. *Radiology* 2002;223:143-151.
 37. Theumann NH, Bittoun J, Goettman S, Le Viet D, Chevrot A, Drape JL. Hemangiomas of the fingers: MR imaging evaluation. *Radiology* 2001;218:841-847.
 38. Gonzales del Pino J, Diez Ulloa A, Lovic A, Relea MF. Sarcoidosis of the hand and wrist: a report of two cases. *J Hand Surg* 1997;22A:942-945.