

SUBCHONDRAL BONE CYSTS

Stephen J. Miller, D.P.M.

Cysts found in the sub-articular bone adjacent to joints afflicted by osteoarthritis or rheumatoid arthritis were identified and described by Plewes in 1940, Collins in 1949, and Landells in 1953 (Fig. 1).



Figure 1. Sub-articular bone cyst in the metatarsal head of patient with rheumatoid arthritis.

However, related subchondral bone cysts with a synovial-like lining were subsequently described by Fisk in 1949 and Hicks in 1956. Over the years, various synonyms for these lesions have appeared in the literature: synovial cysts, juxta-articular bone cysts, intra-osseous ganglia, ganglion cysts of bone, and geodes.

According to the World Health Organization classification of bone tumors and tumor-like lesions, the term juxta-articular bone cyst (intra-osseous ganglion) is defined as "a benign cystic and often multi-loculated lesion made up of fibrous tissue, with extensive mucoid changes, located in the subchondral bone adjacent to a joint. Radiologically, it appears as a well-defined osteolytic lesion with a surrounding area of sclerosis. It has been described as a synovial cyst, but it lacks a synovial lining." As such, the definition excludes the cystic juxta-articular bone lesions seen in conjunction with pigmented villonodular synovitis, as well as other osteolytic bone lesions.

In spite of the great number of descriptive names, these lesions share virtually the same

macroscopic and microscopic characteristics. The cysts are usually solitary, but may be multilocular. They commonly develop in the epiphyseal or metaphyseal areas of bone adjacent to joints. Generally, they have a whitish or bluish lining consisting of parallel bundles of collagen. The fibrocytes lying along the inner wall of the cavity sometimes form an incomplete lining of flattened, synovial-like cells. This makes for a smooth wall within which the cyst contains a thick gelatinous mucoid fluid.

Still, there are those who distinguish the subchondral bone cysts seen in conjunction with osteoarthritis or other joint damage, from intra-osseous ganglia or synovial cysts of bone. The former are more likely to communicate with the joint through the articular surface in up to 40% of the cases, and therefore may be filled with synovial fluid; whereas the latter communicate with the joint in less than 3% of the documented cases and the fluid is more commonly a viscous mucoid material. In fact, the Armed Forces Institute of Pathology, as late as 1971, separated as distinct entities the subchondral bone cysts and the synovial cyst of bone.

Other similar cystic lesions are found in conjunction with silastic joint implants (Fig. 2), and as a consequence of the degenerative changes caused by osteochondral fractures such as those seen in the ankle joint.



Figure 2. Silastic implant degeneration resulting in periarticular multilocular cyst formation.

PATHOGENESIS

Many theories have been proposed to describe the genesis of these lesions. The early theories of "synovial fluid intrusion," either as a primary event from increased intra-articular pressure, or as a secondary event during the healing process when necrotic subchondral bone is removed, is more applicable to the subchondral bone cyst associated with arthritic disease.

In contrast, it is believed that the intra-osseous ganglion is caused by a primary intramedullary metaplasia of the mesenchymal cells into synovial-like cells and/or fibroblasts. This transformation is accompanied by degenerative changes creating the mucin-like substance which is rich in hyaluronic acid. The role of trauma and compressive forces has been postulated, but the association remains unclear.

DIAGNOSIS

Subchondral bone cysts associated with arthritis (especially rheumatoid arthritis) occur in the sub-articular bone adjacent to joints. In the lower extremity, they are most commonly found in the metatarsal heads. Intra-osseous ganglia occur near joints, and in the lower extremity they more commonly occur in the medial malleolus, proximal fibula, proximal tibia, as well as the tarsus area and talus.

Subchondral bone cysts are well known to occur in the first metatarsal head, particularly near the medial eminence in association with hallux valgus. This is commonly true even when there are no radiographically identifiable changes in the joint (Fig. 3).



Figure 3. Subchondral bone cysts associated with hallux abductovalgus deformity.

In the recent literature, a survey by Murff and Ashry of intraosseous ganglia identified of 213 lesions; 43% were found in women and 57% in men, with an average age of 43 years. The most common site was in the lower extremity, especially the distal tibia (Table 1).

Table 1

LOCATIONS OF INTRAOSSEOUS GANGLIA

Upper Extremity	68
Lower Extremity	145
Above Knee	44
Below Knee	101
Prox. Tibia	30
Mid Tibia	1
Medial Malleolus	39
Prox. Fibula	8
Lateral Malleolus	6
Talus	7
Tarsus	7
1st Metatarsal	2
Great Toe	1

(n = 213)

Murff and Ashry JFAS, 1994

Although cystic bone lesions may be asymptomatic, they commonly cause intermittent pain aggravated by increased activity. Joint movement by itself does not necessarily cause pain. The discomfort is thought to be caused by an increased intra-lesional pressure from the accumulation of fluid. However, on rare occasions, pain may result from fracture through the subchondral bone. These lesions tend to weaken the surrounding bone. If there is communication between the cyst and the joint, then the synovial fluid may move back and forth between the two.

Occasionally, pain precedes the radiographic appearance of the lesion. Moreover, subchondral bone cysts have been reported to occur preceding the subsequent diagnosis of inflammatory or degenerative arthritis.

On the radiograph, the lesion usually appears as a well-demarcated circular to oval radiolucent defect outlined by a thin margin of sclerotic bone, usually near a joint. It may be multilocular, but is more commonly unilocular with varying dimensions, ranging from a few millimeters up to several

centimeters in diameter. There is no cortical expansion or periosteal proliferation that occurs due to the presence of these lesions.

Computed tomography (CT) can better delineate the extent of the lesion within the bone, and may help determine if it communicates with the joint (Fig. 4). However, to better determine the soft tissue components, as well as the nature of the fluid within the cyst, magnetic resonance imaging (MRI) is a more precise diagnostic test. The T2-weighted images, in particular, clearly depict the synovial fluid demonstrated by a high signal intensity, and differentiate it from the cartilage which is of lower signal intensity. On T1-weighted images, the cyst is usually of low to intermediate signal intensity, and is surrounded by a very low signal intensity rim. On T2-weighted and short T1 inversion recovery images, the cyst is well-defined and is of a very high signal intensity, due to the presence of fluid.

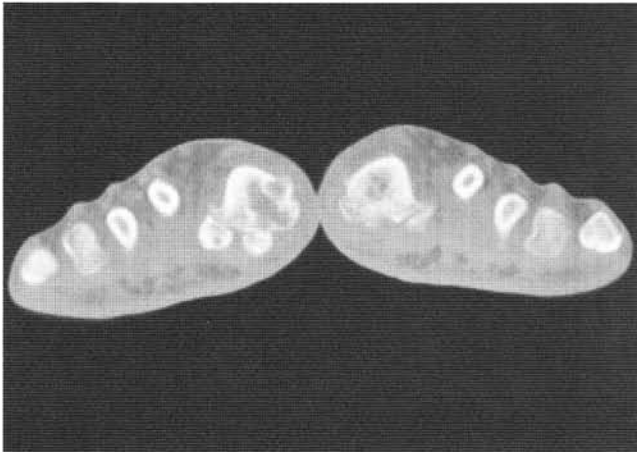


Figure 4. CT scan illustrating bone cysts in the first metatarsal head and adjacent sesamoid bones, communicating with the joint.

Differential Diagnosis

Since these intra-osseous cysts are similar to other lesions of bone, a differential diagnosis must be developed (Table 2). The aneurysmal bone cyst, giant cell tumor, and chondromyxoid fibroma usually cause some expansion of the cortex or a periosteal reaction. Cartilage tumors generally demonstrate intralesional calcification; a finding that is rarely present in intra-osseous ganglia.

TABLE 2

DIFFERENTIAL DIAGNOSIS SUBCHONDRAL BONE CYSTS

Arthritic Cysts
Unicameral Bone Cysts
Other Epiphyseal, Osteolytic Bone Lesions:
Chondroblastoma
Chondroma
Dermoid Fibroma
Osteoid Osteoma
Brodie's Abscess
Tuberculosis
Pigmented Villonodular Synovitis

Unicameral bone cysts are predominantly found in the central shafts of long bones or bodies of short bones (Fig. 5). Other considerations include Brodie's abscess associated with



Figure 5. Unicameral bone cyst in calcaneus. Unlike most intraosseous ganglia, it is not near a joint.

osteomyelitis, and pigmented villonodular synovitis, which generally shows erosive lesions on each side of the joint. Occasionally, a systemic disease such as tuberculosis can produce osteolytic lesions of bone that resemble subchondral bone cysts (Fig. 6).



Figure 6. Cystic lesion caused by tuberculosis.

TREATMENT

Subchondral bone cysts associated with arthritis or arthrosis can improve with intra-articular steroid injection. The increased pressure can be relieved by aspirations of the cyst, with or without the subsequent injection of corticosteroid preparations. For the true intra-osseous ganglia, the lesion can be aspirated and injected quite similar to soft tissue ganglia. However, the incidence of recurrence of symptoms is relatively high.

When symptoms persist in spite of conservative treatment, the usual surgical approach consists of excision of the bone cyst. Curettage is utilized to remove any remaining components of the soft tissue lesion along with the surrounding zone of sclerosis. This is followed by packing of the defect with suitable bone grafting material, usually in the form of allogenic cancellous bone chips. If this material is not available, then a bone substitute may be considered.

The cortical bone covering the subchondral bone cyst should be removed as a plate, so that it can be replaced after the lesion is excised and packed with bone. The success rate of curettage and packing is very high, with only a 7% recurrence rate reported for intra-osseous ganglia.

When various joint procedures are being considered, in the presence of subchondral bone cysts or intra-osseous ganglia, some special considerations are warranted. For example, if an implant is being planned, the bone cyst must be excised and packed, followed by allowing the defect to fill-in before inserting the implant. Conversely, when an implant is removed in the presence of a bone cyst,

the fibrous tissue must be completely curetted, along with the adjacent intra-osseous lesions, so that bleeding cancellous bone is available for any further arthrodesis or grafting techniques that are necessary.

If arthrodesis of a joint in close proximity to a large cystic lesion is being considered, it is recommended to curette and pack the site as described above, and allow it to heal before performing the arthrodesis. This treatment regime is usually successful in relieving the patient's symptoms. However, it is important to inform the patient that reoccurrence is possible, and that the same type of cystic lesion may exist near other joints.

Subchondral bone cysts that result from osteochondral fractures, such as those seen in the ankle joint, require special consideration (Fig. 7). These defects are difficult to pack with bone, since once they are opened into the joint, there is no method of providing coverage with adequate cartilage. The best approach when such a lesion causes considerable pain is to curette the cyst in an open method, or with an arthroscope. This tends to stop the high-pressure pistoning that is thought to be the source of the pain.

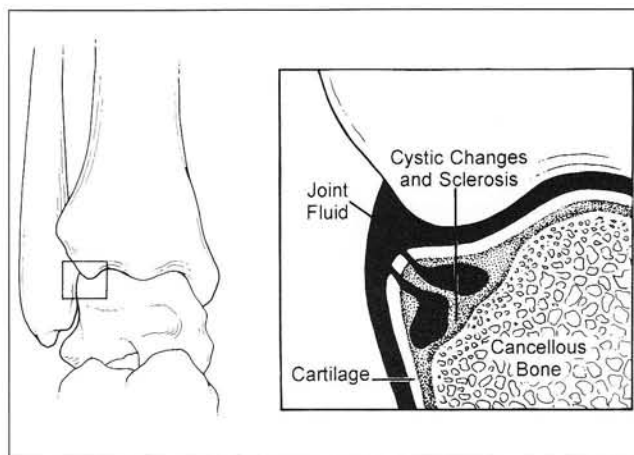


Figure 7. Subchondral bone cyst of the talus secondary to an osteochondral fracture.

BIBLIOGRAPHY

- Aggers GWN, Evans EB, Butler JAK, Blumel J: The pathogenesis, significance, and treatment of suchondral cysts of the iliac acetabulum. *J Bone Joint Surg.*, 41A:766, 1959a.
- Aggers GWN, Evans EB, Butler JAK, Blumel J: Subchondral cysts: a clinical and experimental study. *J Bone Joint Surg* 41A:1352, 1959b.
- Barth E, Hagen R: Juxta-articular bone cysts. *Acta Orthop. Scand.* 53:215-217, 1982.
- Bauer TW, Dorfman HD: Intraosseous ganglion. A clinico-pathologic study of 11 cases. *Am J Surg Pathol.* 6:207-213, 1982.
- Beffa X: Subchondral cysts of the iliac acetabulum. *Arch Orthop Trauma Surg.* 92:259-265, 1978.
- Bywaters EJJ: The Hand. Radiologic Aspects of Rheumatoid Arthritis: *Proceedings of an international symposium.* Excerpta Medica Foundation, Amsterdam, 1963. pp. 43-61.
- Bauer TW, Dorfman HD: Intraosseous ganglion. A clinico-pathologic study of 11 cases. *Am J Surg Pathol.* 6:207-213, 1982.
- Castillo RA, Sallab EL, Scott JT: Physical activity, cystic erosions and osteoporosis in rheumatoid arthritis. *Ann Rheum Dis* 24:522-526, 1965.
- Chiu DWL, Ross S, Salvatori RW: Cystic bone lesion in the fifth metatarsal with subcutaneous rheumatoid nodule. *J Am Podiatr Med Assoc* 82:471-474, 1992.
- Collins DH: *The Pathology of Articular and Spinal Diseases.* Edward & Arnold & Company, London, 1949. pp. 186 & 71.
- Grabbes WA: Intra-osseous ganglia of bone. *Surgery* 53:15-17, 1966.
- Crane AR, Scaranos JJ: Synovial cysts (ganglia) of bone: report of 2 cases. *J Bone Joint Surg* 49A:355-361, 1967.
- Cserati MD: Question of post-traumatic formation of para articular bone cysts. *Z Unfallmed Berufschr.* 68:95-103, 1975.
- DeHaas WHD, DeBour W, Griffioen F, Oosten-Elst P: Rheumatoid Arthritis of the robust reaction type. *Ann Rheum Dis* 33:81-85, 1974.
- Feldman F: Ganglia of bone: theories, manifestations and presentations. *Crit Rev Clin Radiol Nucl Med* 4:303-332, 1973.
- Ferguson A: The pathologic changes in degenerative arthritis of the hip and treatment by rotational osteotomy. *J Bone Joint Surg* 46A:1337, 1964.
- Fisk GR: Bone concavity caused by a ganglion. *J Bone Joint Surg* 31B:220-221, 1949.
- Freund E: The pathologic significance of intra-articular pressure. *Edinburgh Med J* 47:192, 1940.
- Guhl JF, Stone JW, Ferkel RD: Other osteochondral pathology fractures and fracture defects. In Guhl JF: *Foot and Ankle Arthroscopy* 2nd ed, Thorofare, NJ, Slack, 1993, pp 135, 140-145.
- Hicks JD: Synovial cysts in bone. *Aust N Z J Surg.* 26:128-143, 1956.
- Jayson MYV, Dixon A St. J, Yeoman P: Unusual geodes (bone cysts) in rheumatoid arthritis. *Ann Rheum Dis* 31:174-178, 1972.
- Kabbani YM, Mayer DP: Magnetic resonance imaging of osteochondral lesions of the talar dome. *J Am Podiatr Med Assoc.* 84:192-195, 1994.
- Landells JW: The bone cysts of osteoarthritis. *J Bone Joint Surg* 35B:643, 1953.
- Lemont H, Khoury MS: Subchondral bone cysts of the sesamoids. *J Am Podiatry Med Assoc* 75:218, 1985.
- Lemont H, Smith JS: Subchondral bone cysts of the head of the first metatarsal. *J Am Podiatry Assoc* 72:233, 1982.
- Lemont H, Visalli A: Subchondral bone cysts of the phalanges. *J Am Podiatr Med Assoc.* 80:479-481, 1990.
- Lundeen RO: *Manual of Ankle and Foot Arthroscopy.* New York, Churchill-Livingstone, 1992, pp 75-76, 82-84.
- Murff R, Ashry HR: Intraosseous ganglia of the foot. *J Foot Ankle Surg* 33:396-401, 1994.
- Plewes LW: Osteo-arthritis of the hip. *Br J Surg.* 27:682, 1940.
- Rennell C, Mainzer F, Multz CV, Genant HK: Subchondral pseudocysts in rheumatoid arthritis. *An J Roentgenol.* 129:1069-1072, 1977.
- Rhoney K, Lamb DW: The cysts of osteoarthritis of the hip. *J Bone Joint Surg* 37B:663, 1955.
- Resnick D, Niwayama G, Coutts RD: Subchondral cysts (Geodes) in arthritic disorders: Pathologic and radiographic appearance of the hip joint. *AJR* 128:799, 1977.
- Schajowicz F, Ackerman LV, Sissons HA: *Histologic Typing of Bone Tumour.* International Histological Classification of Tumours., No. 6. Geneva: World Health Organization, 1972.
- Schajowicz F, Sainz MC, Slullitel JA: Juxta-articular bone cysts (intraosseous ganglia) *J Bone Joint Surg.* 61B:107-116, 1979.
- Spjut HJ, Dorfman HD, Fechner RE, Ackerman LV: *Tumors of Bone and Cartilage. Atlas of Tumor Pathology.* Second Series, Fasc. 5. Washington, D.C., Armed Forces Institute of Pathology, 1971.
- Thornton D, Farrer AK: Intraosseous ganglion of the cuboid bones. *J Foot Ankle Surg* 32:443-452, 1993.
- Woods CG: Subchondral bone cysts. *J Bone Joint Surg* 43B:758-766, 1961.