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).

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 osteoelastic joint implants such as those seen in the ankle joint.
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 subarticular 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).

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

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

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

**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**

<table>
<thead>
<tr>
<th>Arthritic Cysts</th>
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<tbody>
<tr>
<td>Unicameral Bone Cysts</td>
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<tr>
<td>Other Epiphyseal, Osteolytic Bone Lesions:</td>
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<tr>
<td>Chondroblastoma</td>
</tr>
<tr>
<td>Chronodroma</td>
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<tr>
<td>Dermoid Fibroma</td>
</tr>
<tr>
<td>Osteoid Osteoma</td>
</tr>
<tr>
<td>Brodie's Abscess</td>
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<tr>
<td>Tuberculosis</td>
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<tr>
<td>Pigmented Villonodular Synovitis</td>
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</table>

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 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 osteolotic lesions of bone that resemble subchondral bone cysts (Fig. 6).
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.
BIBLIOGRAPHY


