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Surgical Excision vs. Radiofrequency Ablation for Treatment of Osteoid Osteoma

A systematic review of literature & meta-analysis

Thesis

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List of Abbreviations

Abb.	Full term
CT	*Computed tomography*
MDCT	*Multiple detector Computed tomography*
MR	*Magnetic resonance*
OO	*Osteoid Osteoma*
PRISMA	*Preferred reporting items of systematic reviews and meta-analysis*
RFA	*Radiofrquency ablation*

ABSTRACT

Background and introduction: Osteoid osteoma is a benign osteoblastic tumor that Bergstrand first described in 1930. Jaffe described it in 1935 and was the first to recognize it as a unique entity. Osteoid osteomas are usually smaller than 1.5-2 cm and characterized by an osteoid-rich nidus in a highly loose, vascular connective tissue. The nidus is well demarcated and may contain a variable amount of calcification. Surrounding the nidus is a zone of sclerotic but otherwise normal bone, the nidus varies in consistency from vascular, soft, friable, gritty, and granular to densely sclerotic.

Methods: This systematic review consisted of 5 steps, including a systematic search of the literature (PubMed, SCOPUS, Web of Science, and The Cochrane Library), selection of studies, recording of study characteristics, assessment of methodological quality and bias. and extraction of data on clinical outcomes and their comparisons between different surgical groups.

Results: We compared between 12 studies in 5 clinical outcomes which are: Duration taken until pain relief occurred, Duration of hospital stay, Duration taken for return to normal activities, late complications, rate of recurrence. According to our results we found that there is no difference between RFA and surgical excision in Duration taken until pain relief occurred (p value = 0.321 (non-significant)), late complications (p value = 0.454 (non-significant)), rate of recurrence (p value = 0.279 (non-significant)). Otherwise, there is a difference between them in Duration of hospital stay (p value = 0.001 (significant)), Duration taken for return to normal activities (p value = 0.001 (significant)).

Conclusion: Radiofrequency ablation decreases the duration of hospital stay and decreases the duration taken to return to normal activities which decreases the morbidity and the cost of the procedure also gives better life style.

Keywords: Osteoid Osteoma, surgical excision, radiofrequency ablation

INTRODUCTION

Osteoid osteoma is a benign osteoblastic tumor that Bergstrand first described in 1930[1]. Jaffe described it in 1935 and was the first to recognize it as a unique entity[2]. Osteoid osteomas are usually smaller than 1.5-2 cm and characterized by an osteoid-rich nidus in a highly loose, vascular connective tissue. The nidus is well demarcated and may contain a variable amount of calcification. Surrounding the nidus is a zone of sclerotic but otherwise normal bone, The nidus varies in consistency from vascular, soft, friable, gritty, and granular to densely sclerotic. [3]

Osteoid osteomas are painful lesions of bone that are relatively common, characteristically seen in children and adolescents, with boys affected more than twice as frequently as girls, The characteristic clinical presentation is nocturnal pain.[4]

On physical examination, local swelling may be apparent and the lesion may be exquisitely tender; mild leukocytosis may be present.

- Pain with nocturnal exacerbation, relieved by salicylates and NSAID
- Exquisite, localized tenderness

The typical lesion is located within the cortex of a long bone, and exhibits on imaging studies a central lucent zone (or

nidus) with increased sclerosis of the surrounding bone, which may also show marked periosteal new bone formation. [4]

- **Microscopy:**
  - **Central nidus**
    - Connective tissue
    - Differentiating osteoblasts producing osteoid and sometimes bone
    - With or without osteoclasts
    - Woven immature bone with prominent osteoblasts and osteoclasts
  - **Surrounding sclerotic bone**

Osteoid osteomas are characterized microscopically by a maze of small spicules of immature bone, most often lined with prominent osteoblasts and increased numbers of osteoclasts. In more mature lesions, the intervening stroma is sparsely cellular, with readily apparent vascular spaces. Cartilage matrix formation does not occur. Very rare cases have been observed in which multiple nidi were present. The microscopic appearance of osteoid osteoma may vary with the degree of lesional maturity: [4]

- During the initial stage of the disease, proliferation occurs in osteoblasts and vascularized spindle cell stroma with minimal new bone formation.

- In the intermediate stage, patches of calcified osteoid between the neoplastic stromal cells appear.
- The mature stage manifests with densely packed atypical bony trabeculae with decreased vascularity and stroma.

The histologic stage is not correlated with the patient's clinical picture. [4]

Pathophysiology:

The pathophysiology of osteoid osteoma has been controversial as to whether it is neoplastic or inflammatory. The possible presence of atypical cellular and trabecular components support its being a neoplasia. However, its relatively small size, self-limited nature, and intracellular viral particles (as observed on electron microscopy) may suggest an inflammatory process. [4]

Pain in osteoid osteoma has been typically attributed to the nidus, with its associated hyperostosis and neural elements in the reactive fibrous tissue. Golding described radially oriented trabeculae of surrounding reactive bone, which implied an increased pressure in the vascular nidus. This arrangement of the bony trabeculae was attributed to the stresses placed on them. This increased pressure due to vasodilatation and edema is thought to directly stimulate intraosseous nerve endings, generating pain. Schulman et al supported this observation, finding increased amounts of

unmyelinated nerve fibers, with greatest abundance next to arterioles. These fibers were believed to be sensitive to changes in vascular pressure. [4]

Prostaglandins have been implicated and linked to osteoid osteoma. Several authors have even suggested that they may have a fundamental role in the development of osteoid osteoma. Support is derived from reports of a 100- to 1000-fold increase in levels of prostaglandins, particularly prostaglandins E2 and I2 (prostacyclin), in the nidus that was reversible on extirpation of the tumor. These prostaglandins and other mediators of bone formation and inflammation are believed to provide the final common pathway for pain generation. [4]

Furthermore, the dramatic response to salicylates or nonsteroidal anti-inflammatory drugs (NSAIDs), which affect prostaglandin synthesis, supports the suggested role of prostaglandins in the pathophysiology of pain. Healey and Ghelman described 2 pathways of pain generation due to prostaglandins. The first involves permeability and vasodilatory effects, which increase the size and flow of vessels in the bony lesion, increasing pressure and pain. The second involves its effect in the bradykinin system, which potentiates pain akin to injured soft tissues. [4]

The radiologic differential diagnosis includes a small focus of osteomyelitis or a stress fracture. When the lesion is close to or within a joint (often the hip), The patient may present

with an effusion and symptoms of synovitis. Indeed in such a case, synovial biopsy often reveals a marked lympho-proliferative synovitis. This type of clinical presentation, which is not likely to be immediately diagnosed as osteoid osteoma, is seen in approximately 20% of the cases that are juxta-articular.[4]

Osteoid osteoma can occur anywhere. It can involve a single bone or several bones. Osteoid osteoma is reported to occur in the cortex of the shafts of long bones in 80-90% of cases. It is also reported in the epiphyseal and metaphyseal regions of both small and large bones of the axial and appendicular skeletons, especially the femur, tibia, and humerus, Osteoid osteoms that are close to the epiphysis may cause growth disturbance and deformity [3].

The lower extremities are the most common sites of osteoid osteomas. The femur, particularly the intertrochanteric or intracapsular regions of the hip (Lesser trochanter), is affected in two thirds of cases[5]. The diaphyseal part of the tibia and the humerus are other common sites. Barei et al reported that in 50-60% of cases, osteoid osteoma occurs in the femur and tibia[6].

Approximately 7-20% of osteoid osteomas involve the spine. Involvement here most commonly manifests as painful scoliosis, but painless conditions can also occur. Pettine et al noted that 50% of lesions occur in the cervical spine, and up to 78% of osteoid osteomas in the lumbar spine are associated with

scoliosis [7]. The tumor has a predilection for the posterior elements, most commonly affecting the cancellous lamina, spinous process, and pedicle but sparing the vertebral bodies. Wells et al observed this predilection in 75% of cases, with 33% involving the lamina, 20% involving the articular facets, and 15% involving the pedicles. About 59% of osteoid osteomas affect the lumbar spine. Rates in other areas are 27% in the cervical spine, 12% in the thoracic spine, and 2% in the sacrum [8].

Other areas that may be involved include the hand and foot. Osteoid osteomas of the hand and wrist are rare, most commonly involving the phalanges, and often result in atypical clinical and radiologic characteristics. [9]

Intra-articular osteoid osteoma occurs in 10% of cases and can involve the hip, elbow, and ankle [10].

There are different treatment options for osteoid osteoma including conservative, surgical, and percutaneous techniques [11]. Osteoid osteomas can be treated conservatively with nonsteroidal anti-inflammatory drugs because osteoid osteomas may undergo spontaneous regression after several years [12]. Complete surgical excision is the classic treatment if the conservative treatment fails and the pain persists. But this method needs wide resection of normal bone to ensure complete excision of the tumor [13,14]. Surgery in anatomically difficult sites such as acetabulum, glenoid, and femoral head or neck or lesser trochanter also carries high risk of complications[15].