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Review

Osteoid osteoma of the foot and ankle—A systematic review

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ABSTRACT

Background: Osteoid osteomas are responsible for 10% of benign bone tumours. Treatment typically involves surgical excision or radio frequency ablation. The aim of this systematic review is to evaluate reported cases of foot and ankle osteoid osteomas.
Methods: We conducted a systematic review of the literature using the online databases Medline and EMBASE. We included studies reporting osteoid osteoma diagnosed either radiologically or histologically.
Results: 94 studies were included reporting 223 cases; 70.5% were male, mean age was 23 years, 69% reported night pain and 72% responded to NSAIDs. The commonest affected bone was the talus. CT scan was the most useful radiological investigation and MRI missed the diagnosis in 34% of cases. The majority of patients underwent surgical excision but an increasing trend of ablation therapy was demonstrated.
Conclusions: A high index of suspicion based on salient history and appropriate imaging are essential for timely identification and treatment.

Contents

1. Introduction

The osteoid osteoma was first reported by Jaffe in 1935 as a benign osteoblastic bone tumour typically measuring less than 1 cm [1]. Osteoid osteomas are responsible for 10% of benign bone tumours [2] with half of cases involving either the tibia or femur [3]. The talus is the fourth most commonly affected bone occurring in 2–10% of cases [4,5] The other bones of the foot are less frequently involved but include the calcaneus (2.7%), phalanges (2%) and metatarsals (1.7%) [5].

Osteoid osteomas are classified into cortical, cancellous and subperiosteal subtypes [6]. Long bone osteomas tend to be intracortical and are associated with a high amount of subperiosteal reaction. However the majority of foot osteomas are cancellous or subperiosteal where the periosteal reaction is minimal or absent [7]. The pathogenesis is unknown, some postulate it is due to neoplasia [1] and others propose it is an attempt at repair after no apparent injury [8]. A high level of prostaglandins is produced at the centre of the nidus [9] resulting in increased tension and oedema that stimulate nerve endings

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causing pain. This explains the high level of relief obtained when using non-steroidal anti-inflammatories (NSAIDs).

The clinical presentation can vary dependent on the location of the lesion, but a patient with osteoid osteoma can present with tenderness, swelling or effusion, stiffness and/or restricted activities. The classic presentation of night pain and relief with NSAIDs are common findings with one study reporting the latter in 64% of cases [10]. Males are more commonly affected with reported rates of 67–80% as are those under the age of 25 [11,12]. The time taken to obtain the correct diagnosis can be prolonged and has been reported to vary between a few months to years [13]. The rarity of osteoid osteoma and variability of signs on plain radiographs make diagnosis difficult, and therefore, a high index of clinical suspicion is required to help direct further imaging. Foot lesions are commonly located in cancellous bone or peri-articular where periosteal reaction is minimal or absent making radiograph interpretation difficult [14]. Juxta-articular positioning clouds diagnosis further as symptoms replicate those of a monoarthropathy. For example in the talus the condition can mimic ankle impingement, ankle sprain, ostrigonum and inflammatory arthropathy.

The typical appearance of an osteoid osteoma on plain radiograph is of a core or nidus cavity of 1–2 cm surrounded by a distinctive zone of reactive bone. However cancellous and subperiosteal lesions often show no periosteal response, although a small lytic erosion may be visualised near the chondro-osseous junction [15,16]. Juxta-articular positioning in the foot makes interpretation difficult due to the complexity of the anatomy. Bone scans have been reported to be positive in 100% of cases [17] but they seldom clearly demonstrate the lesion and often show only generalised uptake. Magnetic resonance imaging (MRI) has been reported to miss the diagnosis in 33–35% of cases [18,19] although oedema within the marrow of the affected bone is usually seen [7]. Computerised tomography (CT) is superior to MRI [7,19] and typically demonstrates a low attenuation nidus with focal central calcification and perinidal sclerosis [20].

The condition can spontaneously regress with reports suggesting the majority resolve between two and six years [21]. However, if symptomatic than surgical excision was the traditional treatment [22,23] with success reported between 88 and 100% of cases [24,25]. En bloc resection with excision of the entire lesion and surrounding reactive zone reduces risk of recurrence but this is associated with a higher degree of bone loss. The use of burr and curettage to remove the surrounding reactive bone is advantageous in limiting the amount of bone loss [26]. Difficulty identifying the nidus intra-operatively may result in either failure to fully excise the lesion or excessive bone excision leading to risk of fracture and necessitating bone grafting. This risk can be reduced with the use of imaging modalities either pre- or intra-operatively to guide excision.

Alternative treatments of osteoid osteomas include percutaneous trephine or drilling, ethanol injection and thermal destruction with either laser or radiofrequency ablation. Laser and radiofrequency ablation treatments are performed under radiological guidance with either MR or CT scans. Typically, the procedure is carried out by a team that includes a musculoskeletal radiologist, an anaesthetist and a surgeon. A general or spinal anaesthetic is administered and, under image guidance, entry into the nidus is obtained with either a needle or small drill. The appropriate instrument for ablation is inserted and the position checked under image guidance. Similar results to open procedures have been published with both radiofrequency [27–29] and laser ablation [30,31]. These modalities are less invasive and have the potential advantages of fewer complications and a faster recovery. However, due to the small size of bones in the foot as well as proximity to neurovascular structures, the use of these modalities has been limited.

This systematic review aims to evaluate cases of osteoid osteoma affecting the foot and ankle reported in the literature; analysing patient demographics, symptoms and delay to presentation, diagnostic modalities and treatments for the different bones involved.

2. Material and methods

We conducted a systematic review of the literature using the online databases Medline and EMBASE. The search terms used for the Medline search are shown in Table 1 and this strategy was modified when searching EMBASE. The searches were carried out on the 21st May 2014 and were not limited by year of publication. Only papers available in English and with available abstracts were considered for review.

We included studies reporting participants who were diagnosed with an osteoid osteoma of any bone of the foot and ankle either radiologically or histologically. Both case reports and case series were included. The study must have reported the location of the osteoid osteoma although variable information on patient demographics and treatment did not preclude study inclusion.

Studies were excluded if the location of lesions could not be extracted. In addition, only primary research was considered for review with any abstracts, comments, review articles and technique articles excluded. Eligibility of studies was assessed independently by three authors and any disagreements resolved by discussion.

3. Results

Our search strategy revealed 292 studies. After exclusion of duplicates and implementation of inclusion and exclusion criteria 94 studies were included for full paper review [4,7,13,28,30,32–120]. A flow diagram of this process is demonstrated in Fig. 1. The reasons for exclusion of 100 studies are reported in Table 2. Of the 94 studies included; 64 were case reports [28,32–93] and 30 were case series [4,7,13,30,94–120]. The majority of articles were published after the year 2000 and this chronological frequency is illustrated in Fig. 2. In the 94 studies included for review, 223 cases were reported. The most common bone affected was the talus in 136 cases (61%) as illustrated in Fig. 3.

4. Clinical presentation

70.5% of patients were male and the mean age was 23 years (range 6–64) with the age distribution shown in Fig. 4. Of studies where the age of patients was identifiable, 95% of patient were under the age of 40, and 80% were under 30 years. The majority of patients presented with night pain (69%) although this information was only available in 64% of studies. 72% of patients had found

Table 1
Search strategy for Medline.

Number	Search term	Results
1	Osteoid osteoma.mp. or exp Osteoma, Osteoid/	2615
2	Exp Foot/or exp Foot Joints/or Foot.mp.	109,068
3	Exp Ankle Joint/or exp Ankle/or Ankle.mp.	40,519
4	Calcaneus.mp. or exp Calcaneus/	6983
5	Talus.mp. or exp Talus/	4486
6	Exp Metatarsal Bones/or exp Tarsal Bones/	12,049
7	Exp Toe Phalanges/or Phalanges.mp.	3134
8	2 or 3 or 4 or 5 or 6 or 7	135,123
9	1 and 8	267
10	Limit 9 to (abstracts and English language and humans)	126