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Arthroscopic Management of Osteoid Osteoma of the Ankle Joint: A Systematic Review of the Literature

Susan M. Ge, MDCM[1], Yousef Marwan, BMedSc, BMBCh[1], Abdullah Addar, MBBS[1], Nizar Algarni, MBBS, MSc[1], Ruth Chaytor, MD, FRCSC[2,3], Robert E. Turcotte, MD, FRCSC[4,5]

[1] *Resident, Division of Orthopaedic Surgery, McGill University Health Centre, Montreal, Canada*
[2] *Assistant Professor of Surgery, McGill University, Montreal, Canada*
[3] *Staff Orthopaedic Surgeon and Chief of the Foot and Ankle Clinical Teaching Unit, Jewish General Hospital, Montreal, Canada*
[4] *Professor of Surgery, McGill University, Montreal, Canada*
[5] *Staff Orthopaedic Surgeon and Chief of Surgical Oncology, McGill University Health Centre, Montreal, Canada*

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ABSTRACT

Osteoid osteomas (OOs) are rare benign bone tumors that may occur in various joints including the ankle. These tumors are generally removed via open surgical excision or radiofrequency ablation. However, when they occur intra-articularly, these treatments are more difficult to perform because of more difficult access and the increased risk of damaging articular cartilage. Therefore, some have advocated for the use of arthroscopy to treat these cases. This systematic review aims to investigate the safety and efficacy of arthroscopic treatment for intra-articular OO of the ankle. Using Medline and Embase, we systematically reviewed the literature as of May 31, 2017. All articles published on and before that date were reviewed by 2 independent reviewers. Seventeen articles containing a total of 27 cases were included in the review. Most reported cases were in the talar neck, followed by the distal tibia. Of all the cases, only 2 recurrences were reported (in the same patient), and no complications were reported. Therefore, these cases demonstrate arthroscopic excision of intra-articular OO of the ankle as a safe and effective alternative to open surgical excision and radiofrequency ablation, with a success rate of 96%. However, all articles found were case studies or small case series owing to the rarity of this disease. In the future, analyses of case series with larger case collections should be performed.

Osteoid osteomas (OOs) are benign tumors that make up ~10% to 14% of all benign bone tumors (1,2). Although OO affects the talus in only 2% to 10% of all cases (2), at the ankle it is the most commonly affected bone, with most cases found in the talar neck followed by the tibia (1–3). Patients with OO generally present in the first 2 decades of life with indolent pain that worsens at night. This pain can generally be relieved with salicylates and nonsteroidal antiinflammatory drugs (1,2). Diagnosis is usually made by plain radiographs or computed tomography (CT) scans, which can show a radiolucent lesion with a calcified nidus surrounded by an area of sclerotic bone (1,2). CT can detect OO with 96% sensitivity (2). Magnetic resonance imaging and bone scintigraphy have also been used (1,2,4). These tests, which are generally performed when diagnosis is unclear due to delayed radiologic changes, help demonstrate the inflammatory reaction and exclude other pathologies (4). A technetium bone scan is 100% sensitive in detecting OO (5).

Only ~10% of OOs occur intra-articularly, in the epiphyseal region. However, these are more difficult to diagnose and treat and can cause significant joint damage, along with other sequelae such as muscle atrophy and contractures (1,4,6,7). When intra-articular, OO presents with atypical findings such as joint swelling, stiffness, and synovitis of the affected joint. Along with its rarity, these nonspecific symptoms make diagnosis even more difficult. OO is often mistaken for more common conditions such as monoarthropathy, ankle trauma, or infection (2–4). This results in delays in treatment, sometimes on the order of years (3,4). Initial treatment usually consists of salicylates and nonsteroidal antiinflammatory drugs for pain relief (8,9). If the area continues to be symptomatic despite conservative measures (2), an alternative therapy is removal of the tumor by arthroscopy, a method that may minimize cartilage damage (6,10–12). However, only ~6.3% of OOs in the ankle are treated by arthroscopy, with the most commonly used method being en bloc excision (36.9%) followed by arthroscopy-guided radiofrequency ablation (RFA) (25.6%) (2).

Intra-articular OO causes hyperemia and hypervascularity of the surrounding synovium, classically described as a cherry red elevation, allowing localization of the lesion during arthroscopy (13–16). If this is

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Address correspondence to: Susan M. Ge, McGill University Health Centre, Montreal General Hospital, 1650 Cedar Avenue, Room #B5-159.4, Montreal, QC, H3G-1A4, Canada.
E-mail address: mengxiao.ge@mail.mcgill.ca (S.M. Ge).

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not obvious in some cases, CT scans and other imaging can be used as a guide to resect a small area of bone to reveal the underlying nidus (17–19). Intraoperative fluoroscopy with a C-arm has also been used in localization of the nidus (20,21).

Arthroscopic treatment of intra-articular OO of the ankle was first reported in the late 1990s (22,23). It is believed that arthroscopic treatment offers a less invasive procedure with faster recovery and fewer side effects compared with a standard arthrotomy; however, results lack a high level of evidence. In this study, we aim to systematically review the literature with regard to the use of arthroscopy in the management of ankle OO. We believe that tumor excision and a low recurrence rate can be achieved via the arthroscopic management of intra-articular OO of the ankle joint.

Materials and Methods

Two reviewers (S.M.G., Y.M.) independently searched Medline and Embase for articles related to the arthroscopic treatment of intra-articular OO published on or before May 31, 2017, using the following subject headings and their related key terms: "osteoid osteoma" and "arthroscopy" (Fig. 1 outlines the search strategy used). Inclusion criteria consisted of (1) all levels of evidence, (2) male and female patients, (3) patients of all ages, (4) human studies, (5) English language of publication, and (6) arthroscopic treatment. Exclusion criteria included (1) articles published in abstract form only, (2) any nonsurgical treatment studies (eg, cadaveric studies, conservative treatment, review articles), (3) patients with nonrelated diagnoses, and (4) articles pertaining to OO of joints other than the ankle.

The same 2 reviewers (S.M.G., Y.M.) independently screened the titles and abstracts of the studies found. To ensure completeness, an article was included if 1 of the reviewers believed it should proceed to full-text review. After that, relevant data from the included articles were input into a spreadsheet using Excel for Mac 2011 (Microsoft, Redmond, WA). This included journal/article information (ie, authors, year of publication, sample size, study design, and level of evidence), demographic/clinical data (ie, age, sex, affected side, location of the mass), arthroscopic technique used (ie, patient positioning, arthroscopic portals), length of follow-up, and treatment outcome and complications. Success rate of arthroscopic treatment without recurrence was used as the primary outcome for this review. Because of the heterogeneity of the studies found, meta-analysis was not possible and a qualitative assessment was performed instead. All included studies are level 4 evidence.

Medline May 31, 2017

1) Osteoma, Osteoid/	2720
2) osteoid osteoma*.mp.	2261
3) 1 or 2	3164
4) Arthroscopy/	20314
5) arthroscop*.mp.	29901
6) 4 or 5	29901
7) 3 and 6	86

86 articles total
79 English language, 7 foreign language excluded
Total to review: 79

Embase May 31, 2017

1) osteoid osteoma/	3417
2) osteoid osteoma*.mp.	3720
3) 1 or 2	3720
4) arthroscopy/	16488
5) arthroscopy*.mp.	38143
6) 4 or 5	38143
7) 3 and 6	93

93 articles total
84 English language, 9 foreign language excluded
14 non-repeated, 70 repeats excluded
Total to review: 14

Total from Medline and Embase: 93 articles

Fig. 1. Search strategy.

Results

The initial search amassed a total of 93 studies after duplicates were removed. Fifty-four articles were removed after title review, a further 15 were removed after abstract review, and a final 7 articles were excluded after full-text review. Finally, 17 articles were included in our review (Fig. 2). In total, 27 cases were presented in these articles (Table 1). The 2 reviewers (S.M.G., Y.M.) had no disagreements throughout all stages of the systematic review.

Patient ages ranged from 14 to 46 years, with 14 patients (52%) being female. Of those reporting the affected side, the majority of patients (56%) had OO in the right ankle. Twelve (44%) patients had OO in the talus, most commonly the talar neck, whereas the remainder had OO of the distal tibia. Patients were operated in the supine, prone, or lateral decubitus position, although most cases failed to report operative positioning. Diagnostic delay was very common. One patient was misdiagnosed with an osteochondral lesion, delaying correct diagnosis by 12 months. Three patients underwent other procedures before correct diagnosis. One underwent previous articular debridement for a diagnosis of subtalar cartilage damage, delaying proper diagnosis for 5 months (24). Another 2 underwent previous synovectomy for a diagnosis of synovitis (14,25). In 2 cases, OO nidus was incidentally found during arthroscopy for another diagnosis and later confirmed with pathology (22,25). In the case series of 9 patients by Dimnjakovic et al (6), time elapsed from symptom onset to final treatment ranged from 3 to 60 months. Average follow-up was 19 (range 6 to 36) months, with 2 recurrences in the same patient at 1 and 2 years after initial arthroscopic resection (25). The OO was finally treated by open resection and CT-guided RFA. Therefore, the success rate was 96% (26 of 27 patients) in patients with intra-articular OO treated with arthroscopic removal.

Discussion

Intra-articular OO of the ankle is uncommon and presents with nonspecific symptoms, often resulting in misdiagnosis as a degenerative or traumatic condition and a delay in treatment (2–4). Of the 27 cases reported in our literature review, at least 2 patients underwent other procedures before correct diagnosis of OO. This is likely underreported. These delays and unnecessary procedures may result in further joint damage and other sequelae.

OO has been treated traditionally with a complete surgical resection of the nidus and surrounding sclerotic bone. En bloc resection of the tumor, which is used to ensure no recurrence, generally removes more tissue than necessary and could lead to problems in bone integrity (1,15,26,27). Evidently, this becomes problematic when the lesions are intra-articular, because these areas are less accessible, and there is increased risk of articular damage, leading to the development of osteoarthritis. Although it is reported to be successful 95% to 100% of the time (27), surgical excision is associated with higher rates of infection, cartilage or joint injury, and longer recovery times (15,28).

Image-guided RFA is a minimally invasive alternative to en bloc resection to treat OO. Compared with open surgery, it has similar success rates with fewer complications, faster recovery time, and less bone loss (29). However, 1 disadvantage of RFA is that it requires precise targeting, which may be difficult in intra-articular OOs, which are much less accessible (26). The reported success rate of percutaneous techniques such as RFA is lower than that of open surgical or arthroscopic approaches, at ~80% to 90% (30–33), a recurrence rate of up to 13.5% (34), and a complication rate of up to 24% (34). Outcomes are highly dependent on lesion size and accuracy of needle positioning (35,36). Patients may also be exposed to a high radiation load, as 1 study showed that 9 was the median number of CT scans required for proper needle positioning (35). Despite precautions taken to protect the cartilage, damage may result even if careful technique is used (27).

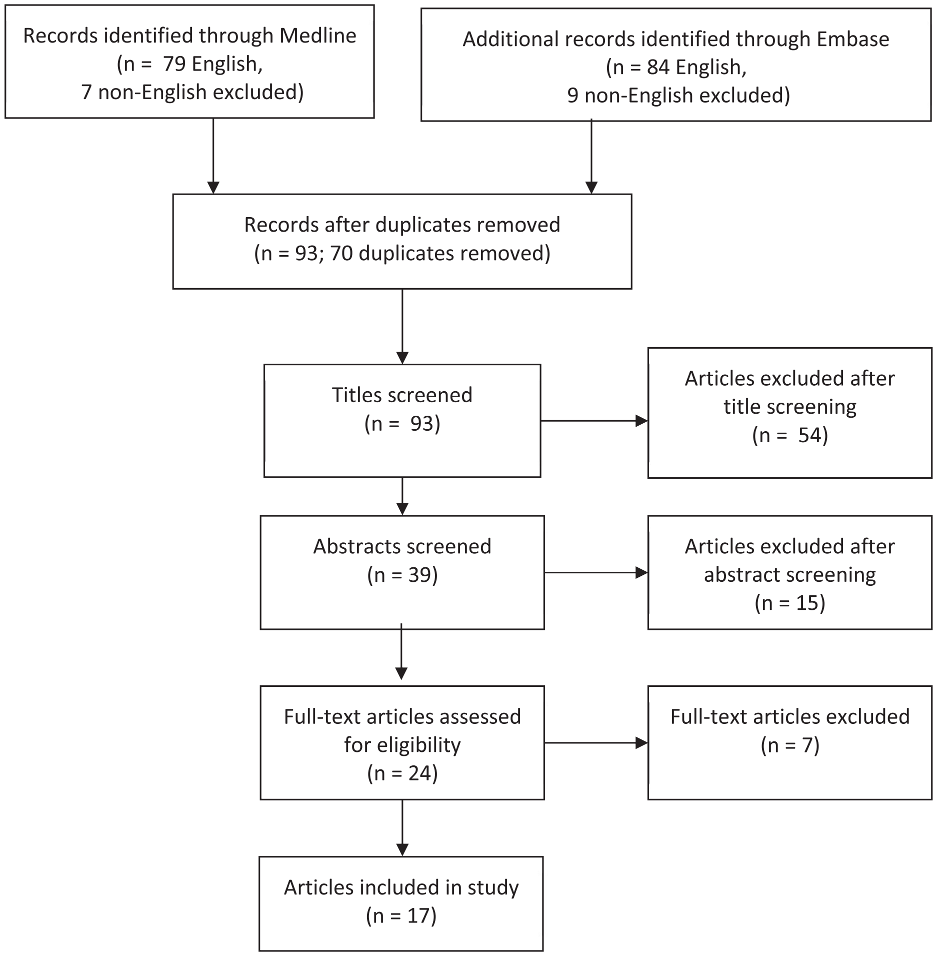

Fig. 2. Flowchart.

Moreover, there have been reports of delayed articular damage with the use of RFA (35,37). Finally, it is harder to obtain material for histological analysis, especially when the lesion is very dense or exceedingly small in size (24,34,38).

Arthroscopic excision of intra-articular OO in the ankle is a relatively new minimally invasive technique. Currently only ~6.3% of intra-articular OO is treated arthroscopically (2). This treatment modality allows for direct visual exploration of the entire joint area, allowing accurate identification of the OO nidus and affected tissues while providing rapid recovery with minimal pain (6,24,28,38−40). Arthroscopic excision also produces a pathology specimen to confirm diagnosis in most cases, regardless of technique. There have been reports, however, in which the use of motorized instruments did not allow a pathology specimen to be obtained (22).

Arthroscopy has a reported incidence of infections of 1.1% to 3% (41−43). Open elective foot and ankle surgery has an overall infection rate of 4%, with rates as low as 2% with strict infection protocols and patient selection (44). Additionally, open surgery has an average length of stay of 5 to 7 days, with a longer recovery period, whereas arthroscopy is a day surgery with much faster rehabilitation (9,24,26,27,45,46). Although cartilage injury with arthroscopic surgery has indeed been reported, it is mostly during the introduction of instruments and not during the procedure itself. It can be prevented using needles and trocars (47), and 78% of injuries are superficial with almost no long-term sequelae at follow-up (47). Open surgery, however, has the potential to damage cartilage, the joint capsule, and ligaments during exposure and increases the chance of fracture, with some authors in the past suggesting prophylactic internal fixation (9,45).

In our systematic review, 12 of the 27 case reports of intra-articular OO were found in the talar neck, which is in agreement with the existing literature (1−3). Although the talar neck is not at the articular cartilage level, it is considered to be intra-articular OO in this review because of its proximity to the joint. OO of the talar neck may cause synovitis, as well as a periosteal reaction that affects the adjacent joint area (48,49). Thus, the disease process symptoms often mimic articular pathologies and may cause joint damage. Moreover, because of its proximity to the joint, OO in this area is accessible for arthroscopic excision.

We found that arthroscopic treatment of intra-articular ankle OO was successful in 96% of cases, with average follow-up of 19 months and no reported complications (Table). This article is the first to present a systematic review about the use of arthroscopy for the management of intra-articular ankle OO and demonstrates the safety and effectiveness of this treatment.

There are several limitations to this review. The only articles found were case reports and a small case series of 9 patients, with no high-quality studies or controlled trials. This is likely because of the rarity of such cases, which makes it difficult to objectively compare arthroscopic treatment versus other treatments. Moreover, techniques used for arthroscopic removal are inconsistent, with different portals used for treating OO in different areas of the ankle, and even for treating OO in the same area of the ankle. Postoperative follow-up was also highly variable, with the longest no more than 36 months. This may miss long-term degenerative changes as well as late recurrences.

In conclusion, from this literature review, we are able to determine that arthroscopic resection has a high success rate comparable to that

Table
Summary of the available literature about the use of ankle arthroscopy for the treatment of intra-articular osteoid osteoma

Study	Type	Sample Size	Gender	Age	Side	Location	Position	Portals	Synovectomy	Remarks	Follow-Up (mo)	Recurrence
Banerjee et al (2005) (14)	Case report	3	See below									
			F	23	L	Talar neck	Supine	Anteromedial, posterolateral; anterior	NR	Initially diagnosed with impingement and synovitis with arthroscopic synovectomy	12	No
			M	13	NR	Talar neck	NR	NR	NR	Excision	6	No
			M	31	L	Tibial plafond	NR	NR	NR	Excision	12	No
Bojanic et al (2012) (15)	Case report	1	M	30	L	Posteromedial portion of the distal tibia	Prone	Posteromedial; posterolateral	NR	Excision	12	No
Bojanic et al (2003) (46)	Case report	1	F	21	R	Talar neck	NR	Anterolateral	NR	Excision	14	No
David et al (2009) (28)	Case report	1	M	23	R	Talar neck	Dorsal decubitus	Anterolateral	Synovial edges	Excision	24	No
Dimnjakovic et al (2015) (6)	Case series	9	6 F; 3 M	Mean 22 (range 14 to 32)	NR	Talus	NR	7 anteromedial, anterolateral; 1 additional distal anteromedial; 1 posteromedial, posterolateral	NR	One case initially diagnosed as synovitis, delay in treatment from symptom onset ranging 3 to 60 mo	24	No
Dubuc et al (2014) (25)	Case report	1	F	19	R	Talar neck	NR	Anteormedial; anterolateral	Yes	Initially diagnosed as synovitis with arthroscopic synovectomy, OO nidus found incidentally and excised	36	At 1 y, treated with arthroscopy followed by open resection; at 2 y, treated with CT-guided RFA
Gao et al (2013) (38)	Case report	1	M	30	R	Talar neck	NR	Anteromedial; anterolateral	NR	Excision	24	No
Gunes et al (2007) (50)	Case report	1	M	18	R	Talar neck	NR	Anteromedial; anterolateral	Yes	Excision with intraoperative fluoroscopic control	15	No
Ikegami et al (2017) (34)	Case report	1	F	16	L	Talar neck	Supine	Anteromedial; anterolateral	Yes	Initially diagnosed with impingement syndrome; confirmation with 3D C-arm–based imaging	12	No
Liu et al (2016) (51)	Case report	1	M	23	R	Talar dome	NR	Anteromedial; anterolateral	No	Excision; autologous iliac crest graft	18	No
Morbidi et al (2007) (24)	Case report	1	M	34	R	Anterior aspect of medial malleolus	NR	2 portals; not specified	NR	Previous ankle arthroscopy for articular debridement; lesion filled with bone wax	12	No
Prado et al (2010) (52)	Case report	1	M	21	R	Talar neck	NR	NR	NR	Excision	36	No
Resnick et al (1995) (22)	Case report	1	F	25	L	Talar neck	NR	NR	Yes	Initially diagnosed with anterior ankle impingement; OO found incidentally on arthroscopy	6	No
Rizzello et al (2010) (40)	Case report	1	F	29	L	Distal tibia	Supine	Anteromedial; anterolateral	NR	Initially diagnosed as osteochondral lesion	36	No
Tuzuner & Aydin (1998) (23)	Case report	1	F	14	R	Talar neck	NR	Anteromedial; anterolateral	NR	Excision	22	No
Winters et al (2011) (53)	Case report	1	F	46	NR	Posterolateral talus	NR	Standard portals; not specified	NR	Excision	4	No
Yercan et al (2004) (39)	Case report	1	M	32	L	Talar neck	NR	Anteromedial, anterolateral, central	Yes	Excision; intraoperative fluoroscopic confirmation	12	No

Abbreviations: 3D, three dimensional; CT, computed tomography; F, female; L, left; M, male; NR, not reported; OO, osteoid osteoma; R, right; RFA, radiofrequency ablation.

of both surgical resection and RFA. Most importantly, it avoids bone destruction and minimizes damage to articular cartilage (6). Ankle arthroscopy appears to be a safe and effective option for the treatment of ankle OO, with a success rate similar to that of surgical excision. This alternative to traditional surgical excision and RFA should be considered in cases where location of the lesion might limit proper resection or cause excessive joint damage. Thus, this is a viable treatment alternative for intra-articular ankle OO. Studies of higher levels of evidence are unlikely, because this is too rare an entity. In the future, case series with larger case collections should be performed. Studies using functional tools may also be beneficial in better understanding intra-articular OO and its treatment.

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