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CLINICAL INVESTIGATION

Percutaneous Biopsy of Osteoid Osteomas Prior to Percutaneous Treatment Using Two Different Biopsy Needles

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Abstract Biopsy is usually performed as the first step in percutaneous treatment of osteoid osteomas prior to laser photocoagulation. At our institution, 117 patients with a presumed diagnosis of osteoid osteoma had a trephine biopsy before a percutaneous laser photocoagulation. Biopsies were made using two different types of needles. A Bonopty biopsy needle (14-gauge cannula, 16-gauge trephine needle; Radi Medical Systems, Uppsala, Sweden) was used in 65 patients, and a Laurane biopsy needle (11-gauge cannula, 12.5-gauge trephine needle; Laurane Medical, Saint-Arnoult, France) in 43 patients. Overall biopsy results were positive for osteoid osteoma in 83 (70.9%) of the 117 cases. The Laurane needle provided a significantly higher positive rate (81.4%) than the Bonopty needle (66.1%; $p < 0.05$). This difference was not due to the size of the nidus, which was similar in the two groups ($p < 0.05$) and may be an effect of differences in needle caliber (12.5 vs. 14 gauge) as well as differences in needle design. The rate of positive biopsy results obtained in the present series with the Laurane biopsy needle is, to our knowledge, the highest rate reported in series dealing with percutaneous radiofrequency ablation and laser photocoagulation of osteoid osteomas.

Keywords Osteoid osteoma · Biopsy · Laser coagulation

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Introduction

Osteoid osteoma is a benign osteoblastic tumor that affects mainly children and young adults. Treatment of choice used to be complete surgical excision. In recent years, several techniques of image-guided percutaneous treatments, mainly radiofrequency ablation [1–5] and laser photocoagulation [6–8], have replaced surgical excision except in some locations such as the spine. Some authors consider the clinical and radiological presentation characteristic enough to bypass histological confirmation [1]. However, other authors still perform biopsy as the first step in percutaneous treatment, to rule out other lesions such as Brodie's abscess [9], chondroblastoma [10], and intracortical hemangioma [11], which may mimic osteoid osteoma.

The percentage of pathological confirmation among series and with the type and caliber of biopsy needles used [2, 5, 8, 12, 13]. We report here our clinical experience with pretherapeutic biopsy of osteoid osteomas with two different needles and compare the percentages of positive histological results obtained.

Materials and Methods

Patients

Institutional review board approval was obtained for this retrospective study. From November 2000 to March 2006, 117 patients with a presumed diagnosis of osteoid osteoma were treated at our institution with percutaneous laser photocoagulation. From November 2000 to December 2004, biopsies were made in 65 patients using a 14-gauge Bonopty biopsy needle with a 16-gauge Bonopty trephine

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needle (Radi Medical Systems, Uppsala, Sweden). From January 2005 to March 2006, an 11-gauge Laurane biopsy needle (Laurane Medical, Saint-Arnoult, France), with a 12.5-gauge trephine needle was used for deep lesions ($n = 43$). During the same period, nine small superficial lesions were biopsied with a 16-gauge Franseen biopsy needle (International Medical Devices, Quistello, Italy) but are not included in this analysis.

Imaging Techniques

All patients were seen during a preinterventionnal consultation and investigated with conventional radiographs and CT scan. Cases were considered typical for osteoid osteoma if they exhibited a round or ovoid central lucent nidus with well-defined margins and a cental calcification. In cases with equivocal CT findings ($n = 19$; central lucent nidus not round or ovoid or not sharply demarcated, absence of central calcification), MRI with nonenhanced and enhanced conventional sequences was obtained. In recent cases ($n = 9$), dynamic sequences after gadolinium injection were added. Case selection for percutaneous treatment was achieved by one of two experienced musculoskeletal radiologists (B.H. has 19 years and J.L. has 27 years of experience) on the basis of the clinical and radiological findings.

Biopsy Techniques

Biopsy was systematically performed during percutaneous laser photocoagulation treatment as the first step in the procedure. The procedure was carried out under CT guidance using either regional or general anesthesia and under strict aseptic conditions. Prior to the procedure, the approach and site of skin puncture were determined from 1-mm-thick contiguous CT sections covering the whole lesion.

The 14-gauge Bonopty set includes an external cannula and an internal drill, which are inserted together after local anesthesia and advanced into the bone up to the nidus margin. The internal drill has an asymmetric tip, making a hole larger than its own size and allowing progressive advancement of the external cannula into the bone (Fig. 1). Once the nidus is reached, the internal drill is replaced by the 16-gauge biopsy trephine needle and the biopsy is performed.

The 11-gauge Laurane needle includes an external cannula and an internal sharp stylet, which are inserted together after local anesthesia and advanced into the bone up to the nidus margin. In cases of very hard bone, the usual cannula and stylet are replaced by a special cutting cannula with a perforating drill (Fig. 2), which allows trephination of hard cortical bone. Once the nidus is reached, the drill is replaced by a 12.5-gauge trephine needle for biopsy (Fig. 3).

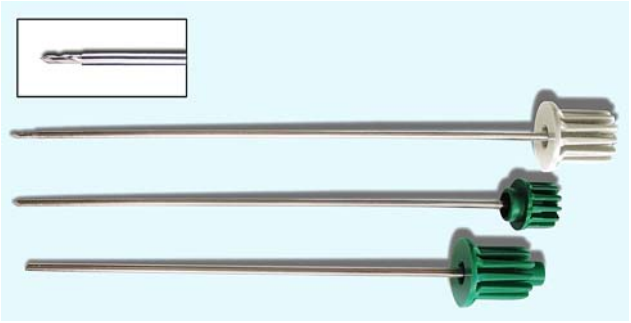

Fig. 1 The Bonopty biopsy needle set. From top to bottom: closeup of the tip of the eccentric drill, the 16-gauge eccentric drill with a white handle, and the 14-gauge external cannula, and its stylet, with their green handle. The eccentric drill has an asymmetrical tip, which allows it to make a hole larger than its own caliber. Therefore, the external cannula can be advanced progressively into the bone together with the drill

To avoid a second needle approach to the patient, and considering our stringent selection criteria, results of the pathological examination of the biopsy specimens were not awaited and laser ablation was carried out in the same session as the biopsy. Pathological examination of the biopsy specimens was carried out by two pathologists specialized in musculoskeletal diseases (27 and 14 years of experience).

Among the 108 patients treated, 4 were lost to follow-up before 6 months and 10 at between 6 and 24 months of follow-up. Median follow-up was 48 months (range: 1 to 97 months). Rate of treatment success, defined as no or minimal intermittent pain with no need for medication, was 94% ($n = 98/104$) at 6-month follow-up and 95% ($n = 89/94$) at 24-month follow-up.

Results

Lesion Location

In the Bonopty group, the 65 lesions were located in the femur (head, $n = 1$; neck, $n = 20$; diaphysis, $n = 17$), tibia ($n = 11$), acetabulum ($n = 3$), cervical spine ($n = 1$), tarsal bones ($n = 3$), humerus ($n = 2$), carpal bones ($n = 3$), metacarpal bones ($n = 2$), and hand phalanges ($n = 2$).

In the Laurane group, the 43 lesions were located in the femur (head, $n = 1$; neck, $n = 10$; diaphysis, $n = 7$), tibia ($n = 12$), spine ($n = 2$), ischial tuberosity ($n = 2$), acetabulum ($n = 1$), fibula ($n = 1$), tarsal bones ($n = 2$), humerus ($n = 2$), carpal bones ($n = 2$), and metacarpal bones ($n = 1$). In 7 of the 43 lesions biopsied with the Laurane needle set, the cutting cannula and perforating drill for hard bone were needed to penetrate a sclerotic bone prior to the biopsy itself.

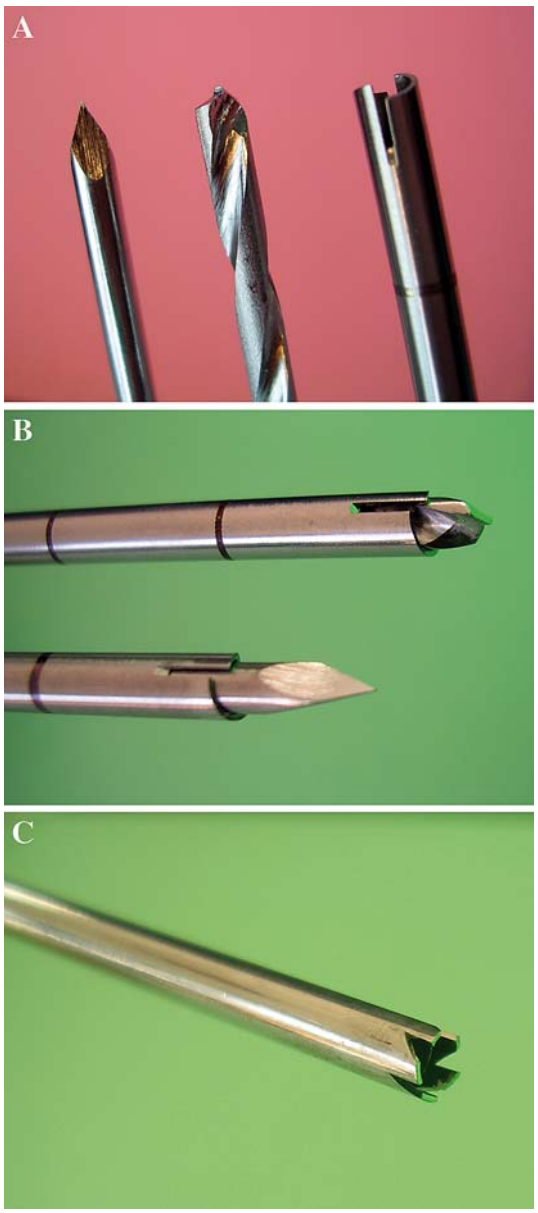

Fig. 2 The 11-gauge Laurane biopsy needle set. **A** From *left* to *right*: distal extremities of the sharp stylet, perforating drill, and cutting cannula for hard bone. The latter two pieces are used together for hard cortical bone trephination. The cutting cannula for hard bone has two slots and two sharp helical cutting edges and may be used in combination with either the perforating drill or the sharp stylet. **B** Tip of the cutting cannula containing the perforating drill (*above*) or the sharp stylet (*below*). **C** Closeup of the tip of the 12.5-gauge trephine needle with five sharp semihelical teeth

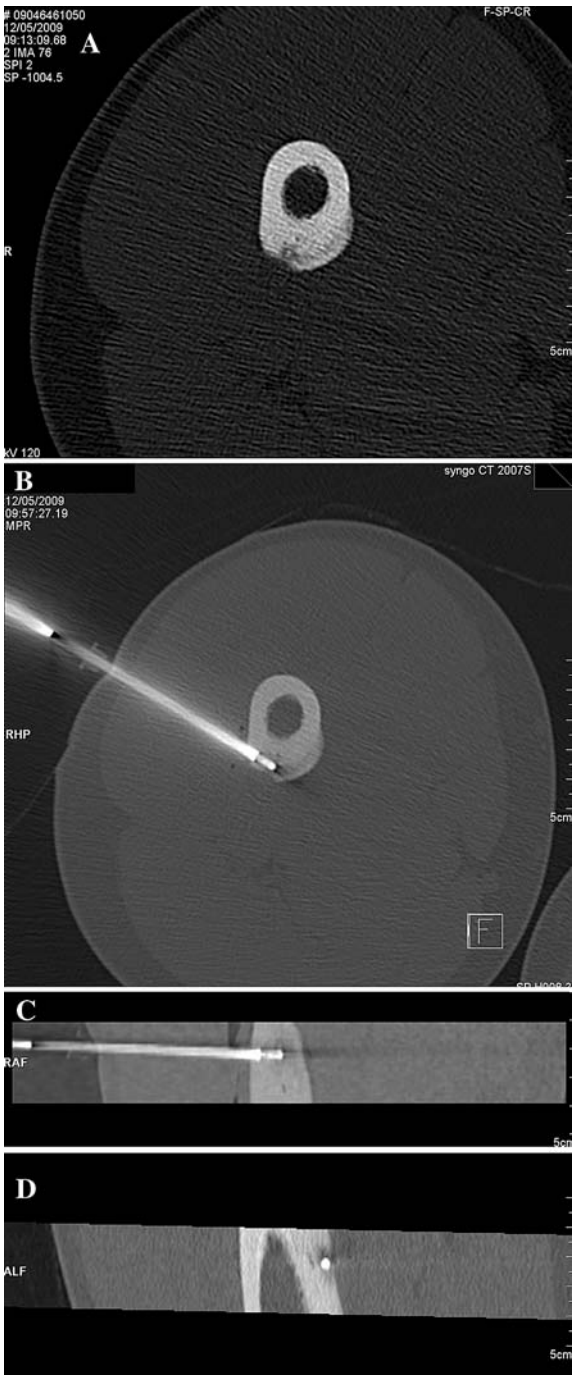

Fig. 3 Example of percutaneous biopsy with the 12.5-gauge trephine needle introduced into the 11-gauge Laurane needle in a case of osteoid osteoma of the posterior cortex of the femoral diaphysis in a 19 year-old boy. **A** Axial CT image showing the small nidus with a central calcification into the posterior cortex of the femoral diaphysis. **B** Axial multiplanar CT reformation. **C** Coronal multiplanar CT reformation. **D** Sagittal multiplanar CT reformation. **B–D** show that the tip of the trephine needle is actually into the nidus in all three planes. In this case, a lateral approach was selected rather than a direct posterior approach to avoid the sciatic nerve

Results of Biopsy

Bone samples from the central lucent area were obtained in 100% of the lesions biopsied with the Laurane needle and in 87.7% ($n = 57/65$) of the lesions biopsied with the Bonopty needle. In the remaining cases, no bone sample

Table 1 Biopsy results using two different trephine needles in a series of 117 osteoid osteomas

Needle	No. of patients	Mean age (range)	Gender ratio, M/F	Mean nidus size (range), mm	Positive biopsy results, %
Bonopty group	65	22 (6–49)	2.82	7.31 (3–15)	66.1
Laurane group	43	20 (6–47)	4.25	8.52 (3–23)	81.4

was obtained despite several attempts. Overall biopsy results were positive for osteoid osteoma in 78 (72.2%) of the 108 cases. Among the 30 negative cases, no bone sample was obtained in 8 cases and normal or nonspecific reactive bone was found in 22 cases. In the Bonopty group, the biopsy was positive in 43 (66.1%) of 65 cases. In the Laurane group, the biopsy was positive in 35 (81.4%) of 43 cases (Table 1). There was no statistical difference in treatment outcome between patients with positive biopsy results and those with nonspecific pathological findings.

Discussion

Due to improvements in imaging guidance and treatment procedures, surgical treatment of osteoid osteomas has been progressively replaced by percutaneous treatments. Even in cases with characteristic clinical and radiological presentation, some of the authors still perform a biopsy during percutaneous treatment of osteoid osteomas [2, 8, 12–14] to rule out mimickers such as Brodie's abscess [9].

Percutaneous resection of osteoid osteomas has been performed using a large variety of trephine needles of large caliber, ranging from 3 to 9 mm [4, 5, 7, 8, 15–17], providing larger specimens for histology in comparison with other ablative techniques [18]. Reported rates of positive findings in percutaneous resection of osteoid osteoma range from 48% to 100% (Table 2) [15, 17, 19–21].

Trephine needles of much smaller caliber (11–16 gauge) have been used to achieve radiofrequency ablation (Table 3). Reported confirmation rates at pathology range from 36% to 73% [2, 4, 5, 12, 13].

A biopsy was not systematically performed in some of the reported series on CT-guided laser photocoagulation therapy [6, 7, 14, 16]. In the study by Gangi et al. [8], a biopsy was performed in 88 of the 114 patients using a 14-gauge Bonopty needle (Radi Medical System, Uppsala, Sweden) or an 18-gauge spinal needle (Becton Dickinson, Rutherford, NJ, USA). The positive biopsy rate was 75%, a rate higher than the one we obtained in the present study with the same needle.

At our institution, biopsy is systematically performed as the first part of the laser photocoagulation procedure. Since the positive biopsy result rate obtained with the Bonopty needle was relatively low (66.1%), we switched to the Laurane biopsy needle set, which provides larger samples and allows easy multiple sampling if needed. The positive biopsy rate obtained in the present series with the Laurane needle (81.4%) was significantly higher compared to that for the Bonopty needle. However, this may be simply an effect of differences in needle caliber (12.5 vs. 14 gauge) rather than in needle design.

We agree that, due to the high specificity of imaging techniques, especially volumetric CT with three-dimensional reformations as well as nonenhanced and dynamic-enhanced MRI, a biopsy is not indispensable prior

Table 2 Biopsy results in reported series of percutaneous resection of osteoid osteomas

Reference	No. of patients	Instrument used	Positive biopsy results, no.
Sans et al. [15]	38	7-mm Kohler trephine needle[a] or 3-mm-bore Laredo biopsy needle	28 of 38 (74%)
Towbin et al. [5]	9	5.5- or 7.9-mm Michel trephine needle[b]	5 of 9 (63%)
Mazoyer et al. [24]	7	3-mm electrically driven drill or 4-mm toothed drill[c]	4 of 7 (57%)
Parlier et al. [8]	30	7-mm Kohler trephine needle[a]	23 of 30 (77%)
Kohler et al. [17]	27	7-mm Kohler trephine needle[a]	13 of 27 (48%)
Voto et al. [9]	9	Corb needle (variable size)[d]	9 of 9 (100%)

[a] Aesculap, Tuttlingen, Germany

[b] Baxter/v. Mueller, Deerfield, IL, USA

[c] Craig-Kogler vertebral biopsy instrument (Lawton, Tuttlingen, Germany)

[d] Zimmer, Warsaw, IN, USA

Table 3 Biopsy results in reported series of radiofrequency ablation of osteoid osteomas

Reference	No. of patients	Instrument used	Biopsy
Rosenthal et al. [3]	263	Bonopty biopsy needle[a] (16 G) or OstyCut needle[b] (16 G)	197 of 271 (73%)
Cribb et al. [6]	45	Bonopty biopsy needle (16 G) or RITA Starburst needle (14 G)	27 of 45 (60%)
Vanderschueren et al. [12]	97	Jamshidi biopsy needle[c] (11 G) or Bonopty biopsy needle[a] (16 G)	21 of 56 (38%)
Lindner et al. [2]	58	Jamshidi needle (11 G) or a 14-G drill system[d]	4 of 11 (36%)

[a] Radi Medical Systems, Uppsala, Sweden

[b] Bard/Angiomed, Karlsruhe, Germany

[c] Sherwood Medical, Belfast, Northen Ireland

[d] Richards Surgical Products, Kalamazoo, MI, USA

to percutaneous treatment of osteoid osteomas. With such imaging techniques, the only conditions which can be confused with an osteoid osteoma are an osteoblastoma in the case of large lesions, a small chondroblastoma in cases located to a bone epiphysis or an equivalent skeletal location, and, less likely, a Brodie abcess or an eosinophilic granuloma. There is no inconvenience, however, to treat such lesions with percutaneous ablation except in the case of a Brodie's abcess, which requires adaptation of the antibiotic therapy to the responsible microorganism. In addition to this, we found that obtaining a pathological confirmation may help to decrease patient anxiety, especially in the small percentage of cases who experience treatment failure or recurrence.

Whatever the sampling technique of the nidus, biopsy or percutaneous or surgical resection, there is a substantial percentage of nondiagnostic biopsy findings in osteoid osteomas. For example, in two recent large series of osteoid osteomas treated percutaneously, the percentage of nondiagnostic biopsy findings was 27% with radiofrequency coagulation [13] and 24% with laser photocoagulation [8]. Nondiagnostic biopsy results were common in reported series of osteoid osteomas treated surgically as well [22, 23]. One possible explanation for the absence of pathological features of osteoid osteoma at biopsy is that such lesions are not true osteoid osteomas. However, all the cases included in our series as well as in the series of Rosenthal et al. [13] had clinical and imaging features characteristic of osteoid osteoma. In addition, there was no difference in outcome after treatment between these two subgroups in either series. Therefore, in agreement with previous authors [13, 23], we believe that the majority of our patients with nondiagnostic biopsy findings did have osteoid osteomas despite the negative biopsy results, and the substantial rate of negative biopsy findings remains unexplained to date. Knowing that, with time, osteoid osteomas may involute and become painless, one possible explanation is that, in some cases, the osteoid tissue of the nidus may undergo progressive maturation into bone, making it undistinguishable from mature bone at histologic examination.

Conflict of interest Two of the others (J.L. and B.H.) are co-inventors of the Laurane needle but guarantee that all the information provided in this article is completely realistic.

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