

# Percutaneous radiofrequency ablation for osteoid osteoma under guidance of three-dimensional fluoroscopy

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## ABSTRACT

**Purpose.** To evaluate the outcome of percutaneous radiofrequency ablation under guidance of 3-dimensional fluoroscopy in 17 patients with osteoid osteoma.

**Methods.** Records of 11 male and 6 female consecutive patients aged 4 to 28 (mean, 13.8) years who underwent radiofrequency ablation under guidance of 3-dimensional fluoroscopy for osteoid osteoma and were followed up for a mean of 15.8 (range, 12–28) months were reviewed. All patients had been treated with analgesics but failed to achieve lasting pain relief. Visual analogue score (VAS) for pain was assessed pre- and post-operatively. Absence of pain was considered recovery.

**Results.** The mean operating time was 55 (range, 20–95) minutes, and the mean length of hospital stay was 2.8 (range, 2–7) days. The mean amount of radiation was 390.2 (range, 330.5–423.6) mGy/cm. Relief of pain occurred within the first 24 hours in 11 patients and by the end of the first week in 3 patients. Pain

persisted in 3 patients at one month; they underwent revision surgery and achieved complete recovery. The mean VAS for pain was 7.2 (range, 6–9) in 17 patients preoperatively and decreased to 0.64 (range, 0–2) in the 14 patients with pain relief and 0.66 (range, 0–1) in the 3 patients after revision surgery. Two patients had severe discharge from the wound secondary to fat necrosis, which resolved within a week with antibiotics and local dressings. No patient had cellulitis, vasomotor instability, neurovascular injury, fracture, or deep infection.

**Conclusion.** Percutaneous radiofrequency ablation under guidance of 3-dimensional fluoroscopy is a viable treatment option for osteoid osteoma.

**Key words:** ablation techniques; fluoroscopy; osteoma, osteoid

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## INTRODUCTION

Osteoid osteoma is a benign bone tumour that occurs predominantly in males and particularly in the young (5 to 20 years).<sup>1–3</sup> Its initial symptom is usually

pain that increases at rest and at night and responds to non-steroidal anti-inflammatory drugs (NSAIDs).<sup>4</sup> Other clinical manifestations include limb-length discrepancy, deformity, and painful scoliosis.<sup>5</sup> The most common site involved is the diaphysis of the long bones, followed by the pelvis and spine. The use of acetylsalicylic acid and NSAIDs is usually the first line of treatment. Resection of the nidus through open surgery or destruction of the nidus using radiofrequency ablation is indicated in patients who fail conservative treatment or who require long-term pain management.<sup>6-11</sup> Radiofrequency ablation under computed tomography (CT) guidance is minimally invasive and has a high success rate.<sup>12-17</sup> Nonetheless, it is associated with a risk of radiation-related complications. This study evaluated the outcome of percutaneous radiofrequency ablation under guidance of 3-dimensional fluoroscopy in 17 patients with osteoid osteoma.

## MATERIALS AND METHODS

Records of 11 male and 6 female consecutive patients aged 4 to 28 (mean, 13.8) years who underwent radiofrequency ablation under guidance of 3-dimensional fluoroscopy for osteoid osteoma and were followed up for a mean of 15.8 (range, 12-28) months were reviewed. All patients had been treated with analgesics but failed to achieve lasting pain relief. They had nocturnal pain and reduced quality of life.

Diagnosis was made using radiography, scintigraphy, CT, and/or magnetic resonance imaging. Images revealed a radiolucent area (nidus) surrounded by a sclerotic rim and cortical thickening (Fig. 1). It involved the diaphysis of the tibia (n=5), femur (n=2), fibula (n=1), humerus (n=1), and phalanges (n=1), as well as the posterior of the iliac crest (n=1), the femoral neck (n=5), and the calcaneus



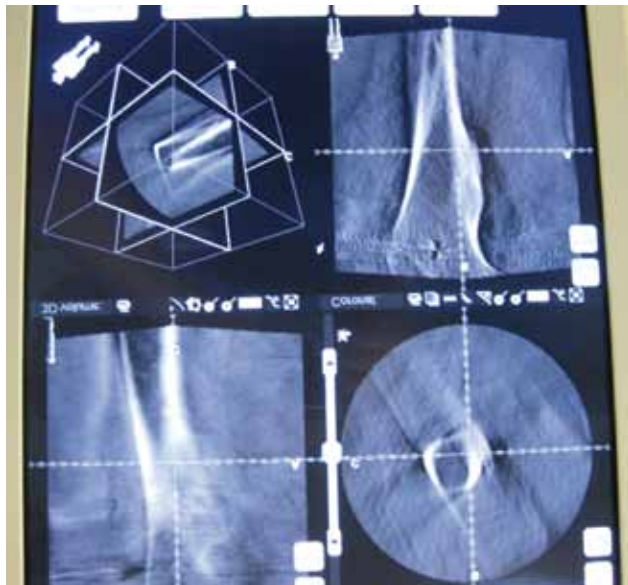
**Figure 1** Preoperative evaluation of the osteoid osteoma in the right femoral neck using radiography and computed tomography



**Figure 2** Placement of the reflector and insertion of the soft tissue protector through the surgical incision.

( $n=1$ ). The mean size of the lesions was 6.9 (range, 4–11) mm.

The patient was placed in the supine or prone position under regional or general anaesthesia, depending on the lesion location. A percutaneous reflector was placed 5 cm from the nidus under fluoroscopic guidance (Fig. 2). The fluoroscope was rotated 135° throughout a one-minute time frame to take 115 images to re-create a 3-dimensional image for the navigation system (Fig. 3). A 2-cm incision was made, and a soft tissue protector was inserted. A 3.2-mm drill was advanced through the protector to



**Figure 3** A 3-dimensional image is re-created with the fluoroscope rotated 135° throughout a one-minute time frame to take 115 images.

open a hole in the cortex for the ablation probe (Fig. 4). The nidus was ablated with radiofrequency; the temperature and time of ablation were based on the lesion size. The wound was sutured, and the sutures were removed on day 15. There were no restrictions on patient activity.

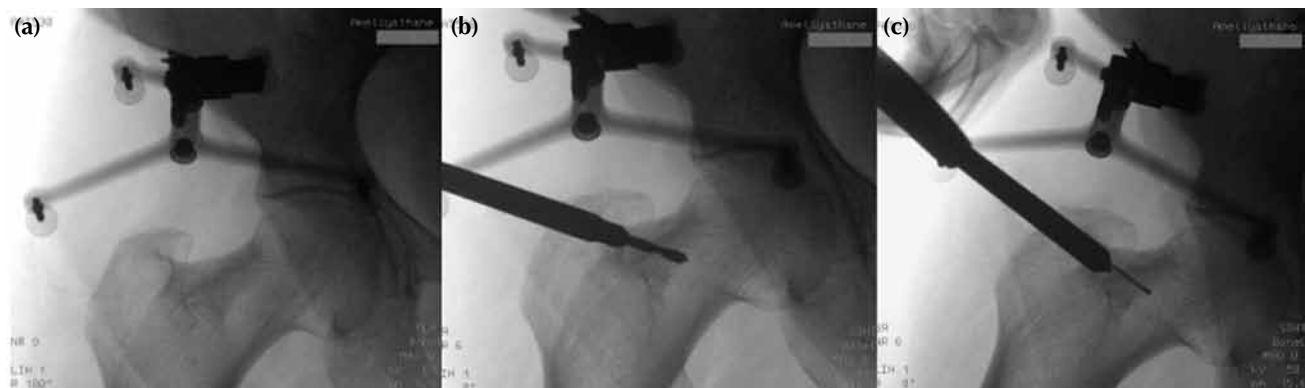
Visual analogue score (VAS) for pain was assessed pre- and post-operatively. Absence of pain was considered recovery.

## RESULTS

The mean operating time was 55 (range, 20–95) minutes, and the mean length of hospital stay was 2.8 (range, 2–7) days. The mean amount of radiation was 390.2 (range, 330.5–423.6) mGy/cm. Relief of pain occurred within the first 24 hours in 11 patients and by the end of the first week in 3 patients. Pain persisted in 3 patients with osteoid osteoma in the posterior iliac crest, tibial diaphysis, or femoral diaphysis at one month; they underwent revision surgery after CT confirmation and achieved complete recovery. The mean VAS for pain was 7.2 (range, 6–9) in 17 patients preoperatively and decreased to 0.64 (range, 0–2) in the 14 patients with pain relief and 0.66 (range, 0–1) in the 3 patients after revision surgery. Two patients had severe discharge from the wound secondary to fat necrosis, which resolved within a week with antibiotics and local dressings. No patient had cellulitis, vasomotor instability, neurovascular injury, fracture, or deep infection.

## DISCUSSION

Surgical excision is indicted in patients who are



**Figure 4** Fluoroscopy showing (a) placement of the reflector, (b) drilling a hole in the cortex, and (c) inserting the ablation probe through the drilled hole into the nidus.

unresponsive to drug treatment.<sup>18,19</sup> Open curettage and wide resection have a success rate over 90%.<sup>2,8</sup> Nonetheless, the complication rate following surgical resection can be 20 to 40%, and complication can include cosmetic problems and fracture. In addition, open surgery is associated with the risk of recurrence, long hospitalisation, and damage to the physis or adjacent joints.<sup>8,18,19</sup>

Radiofrequency ablation under CT guidance has achieved good outcome.<sup>18,20–22</sup> Nonetheless, it is associated with higher exposure to radiation, failure to focus on the lesion, and more complications.<sup>21–24</sup> Although newer CT with dose modulation, helical scanning, and use of more sensitive sensors decreases the dose and radiation-related complications, the overall radiation exposure is still higher than that of 3-dimensional fluoroscopy. Exposure to high-dose radiation at an early age increases the risk of radiation-related complications in future.<sup>25,26</sup> Percutaneous radiofrequency ablation under guidance of C-arm fluoroscopy has the advantages of more accurate determination of the exact location of the lesion and lower exposure to radiation.<sup>6,27–32</sup>

Complications associated with percutaneous radiofrequency ablation include cellulitis, infection

or discharge at the entry site, vasomotor instability, neurovascular damage, and thermal necrosis.<sup>7,20,33–35</sup> Two of our patients had severe discharge who had a lesion in the diaphysis, surrounded by extensive soft tissue. The discharge was secondary to fat necrosis due to the thermal effect. The use of a soft tissue protector is recommended. The learning curve of the system was short; only 3 patients in the early study period required revision surgery. One disadvantage of the system is that no specimens can be obtained for pathology.

Limitations of our study were the small sample size and lack of a control group.

## CONCLUSION

Percutaneous radiofrequency ablation under guidance of 3-dimensional fluoroscopy is a viable treatment option for osteoid osteoma.

## DISCLOSURE

No conflicts of interest were declared by the authors.

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