

# A simple method for percutaneous resection of osteoid osteoma

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## ABSTRACT

**Objectives:** To introduce a method that can be performed with minimal equipments available to most orthopedic surgeons and precludes the extensive anesthetic and ablative requirements.

**Methods:** A percutaneous lead tunnel was first established in the cortex next to the nidus under computerized tomography guidance with local anesthesia; then the nidus was curetted in the operating room through the lead tunnel. The study was performed in Shariati Hospital in Tehran, Iran, from September 2002 to December 2005.

**Results:** Nineteen patients were treated with this method with 94.7% cure rate. The diagnosis was histologically confirmed in 16 cases (84.2%). Failure occurred in one patient. The patients had a mean follow-up of 13.5 months with no recurrence of symptoms with mean hospitalization time of 1.6 days.

**Conclusion:** This technique is simple, minimally invasive and effective. It needs no especial equipments and provides the material for tissue diagnosis.

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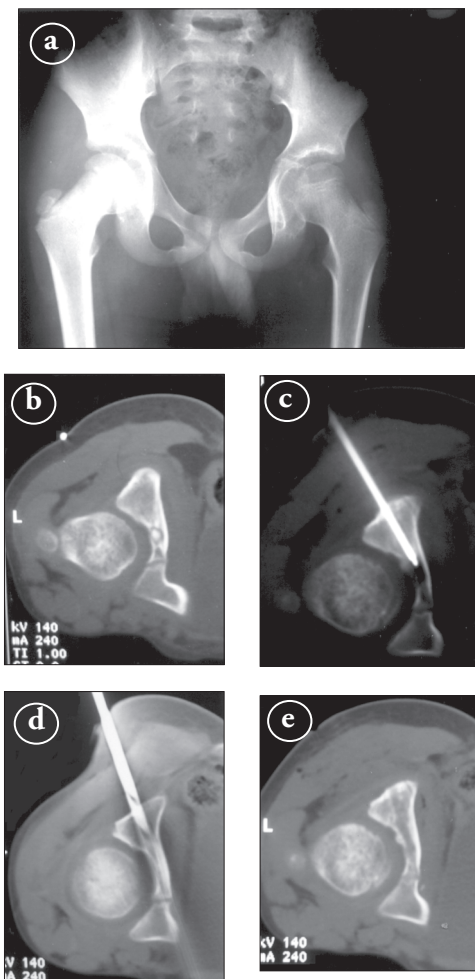
Osteoid osteoma is a benign bone tumor that usually occurs in long bones, pelvis and spine in second decade of life.<sup>1</sup> Clinical presentation and radiographic findings are characteristic for diagnosis. Despite reported spontaneous resolution of tumor with follow-up,<sup>2</sup> many prefer operative excision to long-term nonsteroidal anti-inflammatory drug

(NSAID) use. Three basic surgical methods are currently in practice for excision of this tumor including<sup>1</sup> En block resection, derroofing and curettage, and minimally invasive surgery that encompass a range of modalities such as percutaneous drill resection under computerized tomography (CT) control, local heating techniques, or laser photocoagulation, and chemical sclerotherapy. The minimally invasive methods that have been used in the past decade include mechanical removal of the nidus, local heating, laser techniques and chemical inactivation.<sup>3</sup> Certain technical problems such as difficulties in localization of nidus and the need for considerable bone resection and subsequent bone grafting or fixation make non-invasive methods more appealing. Typically, the nidus is located with the aid of CT<sup>1,4-7</sup> and is excised or ablated non-invasively with radiofrequency or laser ablation. This requires the availability of a CT scanner and anesthetic equipments in the same room which may not be obtainable ubiquitously. The objective of this report is to introduce a method that can be performed with minimal equipments available to most orthopedic surgeons and precludes the extensive anesthetic and ablative requirements.

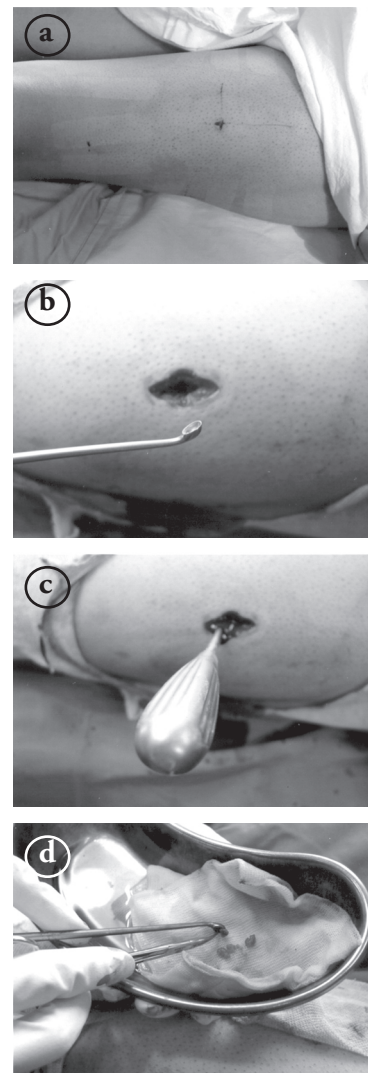
**Methods.** The patients were admitted in our clinic between September 2002 and December 2005, with clinical and imaging findings consistent with diagnosis of osteoid osteoma. The diagnosis was suspected based on clinical symptoms, specifically nocturnal pain and findings on imaging studies, including observation of a nidus in CT scan. After interdisciplinary consultation with radiologist, the patient was then given the option of selecting the treatment method. Those who chose to participate in the study were asked to fill the informed consent. Nineteen patients met the criteria and were admitted finally. After obtaining consent, we

determined the nidus location from patient's CT scan (**Figure 1a**) and outlined the most appropriate course that connected the nidus to the opposite cortex of involved bone. This course would spare the major neurovascular structures in the horizontal plane, level with studied CT cuts. A radiopaque guide (1 mm k-wire) was attached to skin to define the course and 3 mm CT cuts were taken from nidus (**Figure 1b**). Based on the position of nidus and radiopaque guide location, the best entrance point, the appropriate entrance angle and the distance of skin to the cortex next to the nidus were determined. The course, from the skin to the periosteum was

anesthetized with 2% lidocaine. A standard AO/ASIF cannulated screw 2.0 mm guide pin (Synthes-Stratec Inc., Oberdorf, Switzerland) was used to perforate the near cortex and approximate the nidus (**Figure 1c**). The patients tolerated this stage well with local anesthesia. The course of the pin was checked with appropriate CT cuts (**Figure 1c**) and when it was acceptable, a tunnel was created over the pin with standard AO/ASIF cannulated 6.5 mm drill bit (Synthes-Stratec Inc., Oberdorf, Switzerland) (**Figure 1d**). The pin and drill were then extracted and the patient transferred to the operating room. Three leading determinants, the



**Figure 1** - a) Osteoid osteoma of acetabulum in a 9-year-old male, b) the location of nidus was identified by attaching a guide pin to the skin while performing the CT, c) a cannulated guide pin was inserted aiming the nidus based on the obtained data d) cannulated drill bit reams over the guide pin and a tunnel was created. e) The postoperative CT cuts of the nidus area, after curettage of nidus carried out in the operating room.



**Figure 2** - a) Osteoid osteoma of femur in a 25-year-old male. Note the location of previous drilling, b) using a small curette and c) the nidus was curetted through the tunnel created under the CT guide d) and the specimen was sent for histological confirmation.

entrance point on the skin, the tunnel in the near cortex and the entrance angle that have been determined by CT can help locate nidus in the operating room (**Figure 2a**). Using a standard curved curette, aiming the nidus with the above specifications, the nidus was extracted (**Figures 2b & 2c**) and the specimens (**Figure 2d**) were sent for histological examination. Sometimes, the surgeon encounters sclerosis while aiming nidus, this can be overcome by continued drilling through the lead tunnel later in the operating room. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation. We treated 19 patients with this method. The study was performed in Shariati Hospital, Tehran, Iran, from September 2002 to December 2005.

**Results.** A total of 19 patients, including 3 women and 16 men were included. The mean age of patients was 22.1 years old (range 10-47 years). Nightly pain, responsive to NSAID was present in all patients. The mean time interval to diagnosis was 14.5 months (2-60 months). The mean follow up time was 13.5 months (2-36 months). All the patients tolerated drilling the cortex under local anesthesia well, but after reaching the nidus and despite re-injection of lidocaine in the lead tunnel the curettage could not be performed due to severe pain. Therefore, curettage was performed under general anesthesia in the operating room. The resected bony fragments were histologically investigated in all cases. Pathologic diagnosis was compatible with osteoid osteoma in 16 cases (84.2%). In 2 cases (case 5 and 7) cure was achieved, however, the histological diagnosis was nonspecific (sclerotic bone, probable osteoid osteoma). All the 19 patients were pain free 24 hours after the surgery without analgesic usage. Patients with lower limb osteoid osteoma were allowed to bear weight as tolerated immediately postoperatively. All of them had full weight bearing within one week. Complete and permanent resolution of symptoms (pain) was achieved in 18 of 19 patients. Failure occurred in one patient with recurrence of symptoms, the histological diagnosis of which was enchondroma (case 15). She had unsuccessful open surgical nidus resection 4 months before our procedure. Symptoms recurred with one-month delay in this case. Surgical cure was achieved in other 18 cases (94.7%). No complications were reported in any of the cases. Three of our patients had previous failed operative attempts for excision of tumor from which, 2 cured after our procedure. Mean hospitalization time was 1.6 days for the patients. The location of nidi in 16 cases was in lower extremity. Details of the patients can be observed in **Table 1**.

**Discussion.** Noninvasive methods were introduced as a means to overcome the problems associated with common methods of excision of osteoid osteoma including difficult localization of tumor, extensive dissection, the need for bone resection and subsequent bone grafting and internal fixation and difficulties in reaching anatomically inaccessible areas. Traditional surgical treatments ranging from local resection with a burr and curettage to wide resection with bone grafting and metallic fixation have been used for treatment of osteoid osteoma. One study<sup>8</sup> compared curettage with burr to wide local excision and found 100% success in both groups, local drilling group had less immobilization time and shorter duration of protected weight bearing. The surgical specimen allows histological confirmation. Histological examination not only confirms the diagnosis but also is a sign of success of treatment. In another study that osteoid osteoma excision had been performed without histologic confirmation, symptoms were not resolved or recurred in 43% of patients.<sup>5</sup> Wide local excision offers very favorable cure rates. Jackson et al<sup>9</sup> looked at 860 cases and found a recurrence in only 4.5% of cases. Percutaneous resection of the nidus under CT guide is a less aggressive technique. Procedure time ranges from 1.25 to 4 hours which tend to be longer than other ablative techniques.<sup>10</sup> This can be performed as an inpatient or outpatient treatment with histological confirmation in 50-100% and success rates of 77-100%. Postoperatively, morbidity is high in comparison with radiofrequency techniques 87-100% of patients treated with laser interstitial therapy had a successful treatment. However, it has not been used on large scale, primarily due to the cost of the laser generator and probes Real-time guidance with MRI-compatible probes now makes ablative treatment a possibility.<sup>11</sup> The minor complication rate is higher than in radiofrequency therapy. The proposed method, apart from being noninvasive and simple, is performable by conventional orthopedist, and has shown to be effective with reasonable follow-up (mean of 13.5 months). Most current noninvasive methods need anesthesia facilities in CT room.<sup>1,12-15</sup> In addition, expensive especial equipments like laser or radiofrequency generators are needed. Our method does not need complicated or expensive anesthetic and therapeutic facilities and is performable in centers with conventional CT facilities. Although diagnosis of osteoid osteoma is usually possible by clinical and imaging techniques, sometimes it is very difficult to distinguish between stress fracture or Brodie's abscess and osteoid osteoma. In these situations, a positive histological diagnosis can be helpful in confirmation of treatment method,<sup>1</sup> hence; surgery has remained to be the standard treatment in cases where the nature of

lesion is in doubt.<sup>16</sup> As shown above, the specimen for a histological diagnosis was available for most of our cases and we believe that the proposed method can be useful in cases where a histological diagnosis of osteoid osteoma is necessary. Open surgery has been recommended in cases where neurovascular structures are within 1.5 cm of the lesion.<sup>16</sup> The technique introduced here can spare neurovascular structures during the approach to tumor in anatomically inaccessible areas. Because the patient is conscious in the first part of operation, a continuous monitoring of neural status can be performed throughout the procedure. Comparing this technique to other commonly performed noninvasive methods

of ablation of osteoid osteoma, we had an acceptable success rate of 94.7% with no recurrences at mean 13.5 months follow-up. The reported rates of clinical success rate after open surgery have been from 88-100%, with radiofrequency ablation 76-100% with Laser interstitial thermal therapy 87-100% and with other imaging-guided methods of resection 77%-100%.<sup>16</sup> Similar to other noninvasive methods of resection, ambulation can be resumed as soon as possible with this technique and the hospitalization time is quite short (mean 1.6 days), distinguishingly decreasing the costs in comparison with conventional surgical excision of osteoid osteoma, taking away the need for

**Table 1** - Patient characteristics.

| Patient's no. | Age | Sex | Typical symptoms | Symptom duration | Time interval to DX | Localization      | Pathology    | Evolution              | Follow-up | Complication | Prev. open surgery |
|---------------|-----|-----|------------------|------------------|---------------------|-------------------|--------------|------------------------|-----------|--------------|--------------------|
| 1             | 10  | M   | Yes              | 6                | 6                   | Acetabulum        | Oo           | Cure                   | 36 mo     | No           | No                 |
| 2             | 18  | M   | Yes              | 8                | 8                   | Femur             | Oo           | Cure                   | 30        | No           | No                 |
| 3             | 30  | M   | Yes              | 29               | 29                  | Femur             | Oo           | Cure                   | 27        | No           | No                 |
| 4             | 24  | M   | Yes              | 12               | 12                  | Tibia             | Oo           | Cure                   | 17        | No           | No                 |
| 5             | 32  | M   | Yes              | 12               | 12                  | T11 body          | Ns           | Cure                   | 17        | No           | No                 |
| 6             | 28  | M   | Yes              | 24               | 24                  | Tibia             | Oo           | Cure                   | 16        | No           | No                 |
| 7             | 18  | M   | Yes              | 15               | 15                  | Acetabulum        | Ns           | Cure after 2nd surgery | 9         | No           | No                 |
| 8             | 21  | M   | Yes              | 8                | 4                   | Tibia             | Oo           | Cure                   | 14        | No           | No                 |
| 9             | 19  | F   | Yes              | 60               | 60                  | Femoral neck      | Oo           | Cure                   | 14        | No           | No                 |
| 10            | 22  | M   | Yes              | 36               | 36                  | Distal of humerus | Oo           | Cure                   | 13        | No           | 2 times (open)     |
| 11            | 15  | F   | Yes              | 12               | 12                  | Femoral head      | Suspected Oo | Cure                   | 13        | No           | No                 |
| 12            | 24  | M   | Yes              | 60               | 24                  | Tibia             | Oo           | Cure                   | 10        | No           | 1 time (open)      |
| 13            | 18  | M   | Yes              | 6                | 2                   | Femur             | Oo           | Cure                   | 9         | No           | No                 |
| 14            | 17  | M   | Yes              | 6                | 3                   | Head of fibula    | Oo           | Cure                   | 8         | No           | No                 |
| 15            | 47  | F   | Yes              | 24               | 12                  | Toe               | Enchondroma  | Failure after 1 month  | 6         | No           | 1 time (open)      |
| 16            | 20  | M   | Yes              | 5                | 5                   | Femur             | Oo           | Cure                   | 4         | No           | No                 |
| 17            | 24  | M   | Yes              | 5                | 5                   | Distal of ulna    | Oo           | Cure                   | 2         | No           | No                 |
| 18            | 21  | M   | Yes              | 5                | 4                   | Tibia             | Oo           | Cure                   | 2         | No           | No                 |
| 19            | 14  | M   | Yes              | 6                | 4                   | Tibia             | Oo           | Cure                   | 2         | No           | No                 |

Oo - Osteoid osteoma, Prev. - previous

postoperative casting or orthotic treatment.<sup>8</sup> In our proposed method, although the diameter of lead tunnel (4.5 mm) was relatively larger than the tunnel created in other non-invasive methods (2 mm and less),<sup>10</sup> full weight bearing was allowed immediately postoperatively because only one cortex was violated intraoperatively. From our point of view, our proposed method is simple, safe and easy to perform with conventional facilities. This method is a good alternative to the direct surgical approach because of its precision in nidus localization and minimal bone resection and subsequent benefits of short hospitalization, immediate full weight bearing and quick return to socio-economic activities. Furthermore, anatomically difficult to reach locations of the nidus (for instance the acetabulum) represents another good indication for the method. Accurate pre-operative diagnosis has now become possible with recent advances in imaging techniques; albeit, this method can provide confirmatory material for histological diagnosis.

**Acknowledgment.** *The authors declare that the experiments conducted in this study have complied with the medical, ethical and legal principles of the country where the study was performed and after obtaining informed consent from the patients.*

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