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Role of Computed Tomography Guided Radiofrequency Ablation in Treatment of Osteoid Osteoma

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ABSTRACT:

Background: Osteoid osteoma is a small, benign neoplastic, painfulbonelesion with characteristic clinical and imaging features.Computed tomography is now considered theimaging modality of choice as it not only aids in the visualization of the nidus but also contributes in treatment planning. Percutaneous radiofrequency (RF) ablation, which involves the use of thermal coagulation to induce necrosis in the lesion, serves as a minimally invasive alternative to classical surgical treatment of osteoid osteoma

Aims and objectives: To evaluate role of CT guided radiofrequency ablation in the treatment of osteoid osteoma.

Material and Methods

5 patients (4 males and 1 female) with characteristic findings on CT, MRI, and/or scintigraphy with consistent and typical clinical findings of osteoid osteoma were treated with percutaneous CT guided radiofrequency ablation technique.

Results: In our study the patients evolved with complete resolution of the symptoms and radiological findings until the present.

Conclusion:RFA of Osteoid osteoma should be considered in the first line curative treatment of osteoid osteoma.It is relatively low cost and minimally invasive, with high success rates and low recurrences.

Key Words: Osteoid osteoma, RFA, CT guided

I. INTRODUCTION:

Osteoid osteoma is a small, benign neoplastic, painful bone lesion with characteristic clinical and imaging features.Computed tomography is now considered the imaging modality of choice as it not only aids in the visualization of the nidus but also contributes in treatment planning.Traditional curative treatment includes complete surgical excision of the nidus, which is known to give good symptomatic relief. However, drawbacks of the conventional block resection include difficulty of localising the tumour on table intraoperatively, the need for prolonged hospital stay, and higher morbidity starting from hematoma and infection at the operated site to fracture of the created defect post procedure.

Percutaneous radiofrequency (RF) ablation, which involves the use of thermal coagulation to induce necrosis in the lesion, serves as a minimally invasive alternative to classical surgical treatment of osteoid osteoma. With reported high success rates approaching up to 90%, RF ablation should be considered among the primary options available for treating this condition.

Osteoid osteoma is a benign primary bone lesion accounting for about 10 % of all the tumors. There is a male predominance with most of the affected patients being young, half of them presenting in the first 2^{nd} to 3^{rd} decades of life. The lesion can affect any bone in the body, but is found to most commonly involve the long bones of the lower extremity, particularly the meta diaphyseal regions of the femur and tibia. Other common sites include the spine, hands, and feet. Clinically, patienttypically presents with bone pain, which often worsens at night and is usually dramatically relieved by aspirin or othernonsteroidal anti-

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inflammatory drugs. Less common manifestations depend upon the site of involvement and includes growth disturbance, bone deformity. If the lesion is located within a joint capsule, it may cause joint swelling, synovitis, and restricted mobility. Radiological modalities including radiographs,computedtomography(CT), Magnetic resonance imaging (MRI) and bone scan show typical imaging findings which along with the classical clinical presentation aids in arriving at the diagnosis, treatment planning and follow up of these patients during post intervention period.

Radiographic finding includes circular or ovoid cortical lucency representative of the nidus (usually less than 1.5 cm in diameter) witha variable degree of surrounding sclerosis. Intramedullary and subperiosteal lesions may not demonstrate significant osteosclerosis, and the cortex overlying the site may appear normal, making intraoperative surgical localization difficult.

CT is now considered the imaging gold standard investigation of choice as it provides the best characterization of both the nidus and the surrounding cortical sclerosis.

MRI is found to be helpful, especially in diagnosis of lesions involving the medullary region or those periarticular in location.

Dynamic contrast enhanced MR Imagingmakes the nidus readily visible and help improve overall diagnostic accuracy in cases with indeterminate findings at CT or unenhanced MR imaging.

Radionuclide skeletal scintigraphycharacteristically reveals intense activity at the site of the nidus and relatively decreased activity in the surrounding reactive zone, a pattern referred to as the double-density sign.Macroscopically, osteoid osteoma is generally a small wine colored well delimited lesion.

Histologically, osteoid osteoma is composed ofhighly vascular osteoid matrix and a mature intertwined bone trabecula.

TREATMENT OPTIONS INCLUDE:

Medical management with aspirin or NSAIDS, which may provide symptomatic relief, but requires long term therapy. Intra articular/ peri articular lesions may not respond to medical management.

Conventional block resection was historically considered the treatment of choice, but isan invasive procedure. Postoperative complications include hematoma, osteomyelitis, and fracture.

Percutaneous thermal RF ablation is considered a safe, minimally invasive and effective procedure with high accuracy in locating and treatment of the osteoid osteoma and should be considered the current method of choice for treatment.

MATERIAL AND METHODS

5 patients (4 males and 1 female) with characteristic findings on CT, MRI, and/or scintigraphy with consistent and typical clinical findings of osteoid osteoma were treated with percutaneous CT guided radiofrequency ablation technique.

The mean age at presentation was 20 years (range 11–32 years). The diagnosis was made based on the typical clinical and imaging features of the lesion.All patients had received medical therapy with NSAID before the procedure.All the patients underwent a diagnostic CT scan.And in some patients MRI scanning / Radionuclide scanning was also performed before and after the procedure.

The median nidus size was 10 mm (range 4.6 mm –17.5 mm).One of the patients had previously undergone surgery for the lesion and presented with recurrence.

Patients were informed of alternative treatments and informed consent was obtained from the patients or their parents.Samples for histopathological confirmation was sent wherever possible.

LIST OF THE PATIENTS INCLUDED IN OUR STUDY

	AGE (YEARS)	GENDER	LOCATION
CASE 1	11	MALE	MIDSHAFT TIBIA
CASE 2	32	MALE	RIGHT UPPER HUMERUS
CASE 3	29	MALE	POSTEROR LAMINA OF DORSAL VERTEBRA
CASE 4	13	FEMALE	MIDSHAFT OF TIBIA (RECURRENT)
CASE 5	15	MALE	LESSER TROCHANTER OF FEMUR

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PROCEDURE AND TECHNIQUE

Procedure is performed under general anesthesia and CT guidance.

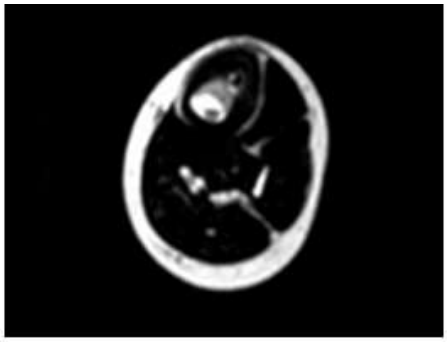
Lesion was localized by acquiring thin-section CT images at the level of the osteoid osteoma.

The route was planned so as to avoid any adjacent neurovascular structures.Grounding pads were then put in place to inhibit the transmission of current through the patient. The grounding pad and the RF electrode was connected to the RF generator. The generator was activated to desired electrical impedance value. The skin overlying the lesion was prepared and draped in accordance with sterile technique.Pre procedure antibiotics and analgesic were administered and continued during the post procedure period.The lesions were targeted using bone hard introducer and CT guided radiofrequency ablation of the lesion was performed using ablation electrode.Course of tissue ablation was obtained by means of direct measurement of the impedance feedback from the target tissue.Biopsy of the lesions were performed wherever possible (In larger lesions)and histopathological confirmation was obtained. Patient's vitals including heartrate, respiratory rate and blood pressure was monitored throughout the procedure.Sterile dressing was applied at the penetration site.Antibiotics and analgesics were continued in the post procedure period.

For larger lesions (more than 10 mm),Overlapping ablationwere done to achieve complete ablation.

In one of the cases in our study, spinallesion which involved the posterior lamina of a dorsal vertebra was noted, epidural air insufflation was performed to avoid thermal injury to the neural structures.

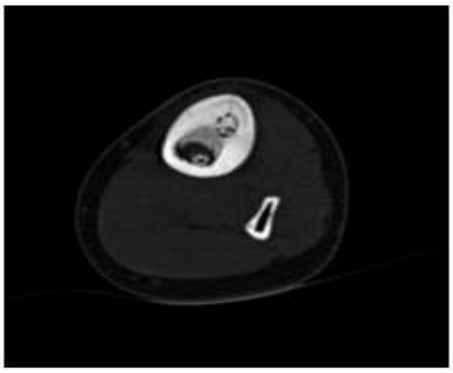
CASE- 1



a

b

(a,b)Axial and coronal T2W MRI images showing a well-defined lesionin the shaft of the tibia predominantly involving the cortex



c

d

(c,d)Axial and coronal CT images showing well defined lytic lesion with sclerotic margins.

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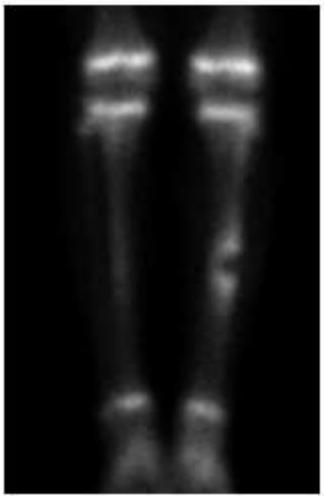
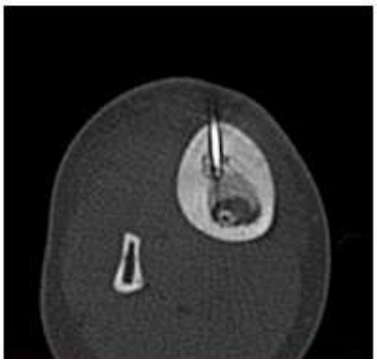


e

(e)Bone scan showing increased uptake over the midshaft of the tibia within the lesion.



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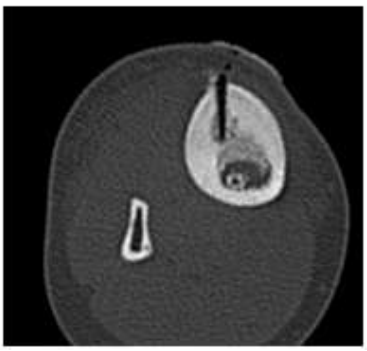

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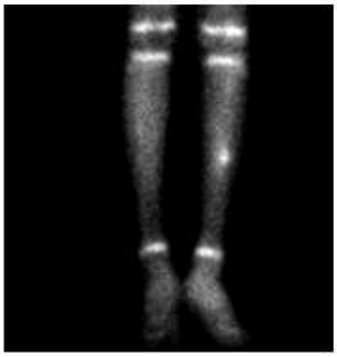
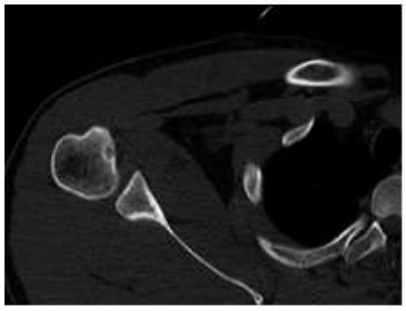


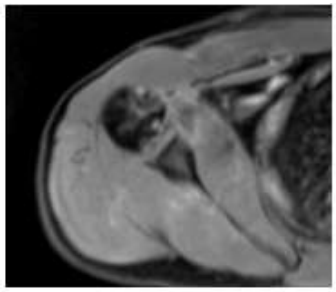
h

(f)CT Confirms the placement of the ablator needle within the lesion.
(g)Post procedure check CT shows the needle tract.
(h)Repeat bone scan done 48 hours post procedure shows complete resolution of the uptake from previous scan with increased surrounding uptake due to reactive bone.

CASE – II



a



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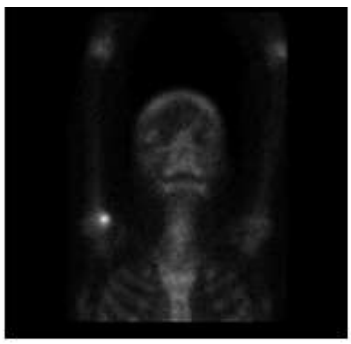

c

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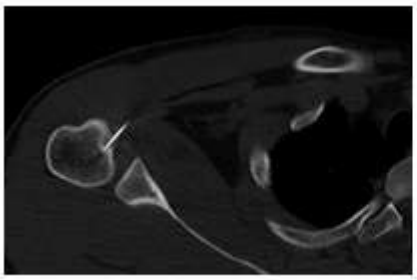
32-year-old male patient presented with right shoulder pain.

a) Non enhanced CT image shows well defined lytic lesion with sclerotic margin in the medial aspect of the upper end of the humerus.

b) Contrast enhanced MRI showing enhancing vascular nidus.

c) Bone scan shows central area of intense uptake within the lesion with surrounding area of lesser uptake .



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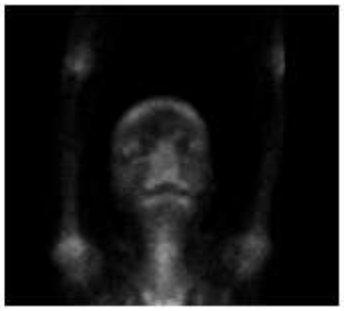
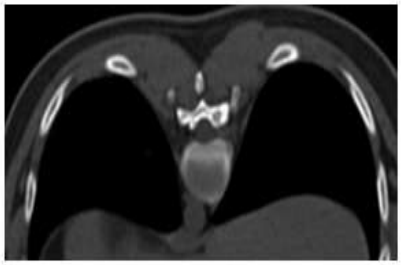


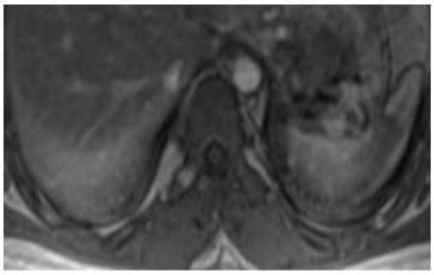
e

d)Axial CT image Confirming the placement of the ablator needle within the lesion.

e)Repeat bone scan done 48 hours post procedure shows complete resolution of the uptake from previous scan with increased surrounding uptake due to reactive bone.

CASE – III





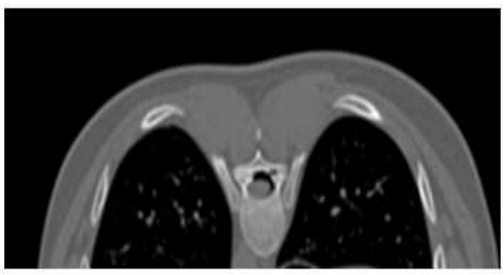
a b

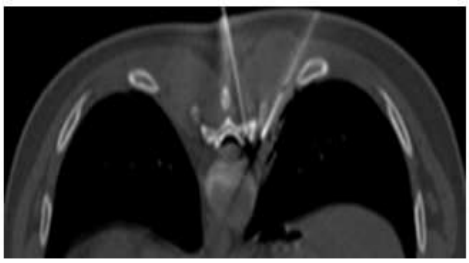
29 year old male patient presented with disabling back pain.

a) Non enhanced CT image(prone) shows osteoid osteoma involving the posterior lamina of D10 vertebra.

b) Contrast enhanced MRI showing enhancing nidus.

Bone scan shows increased uptake within the lesion





c d

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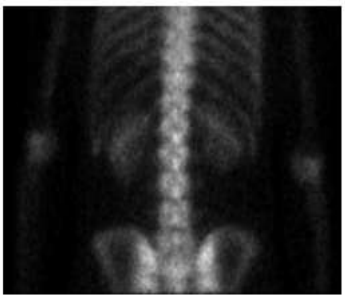
(c)Axial CT prone image – showing air within the spinal canal. Epidural air insufflation was performed to obtain adequate insulation.

(d)Subsequent Confirmation of placement of the ablator needle within the lesion.



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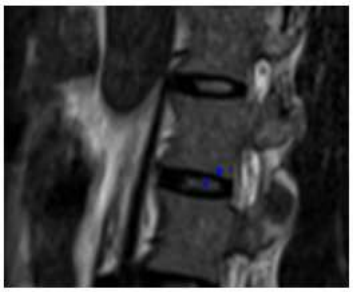

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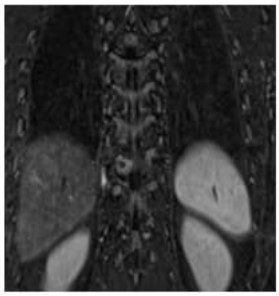


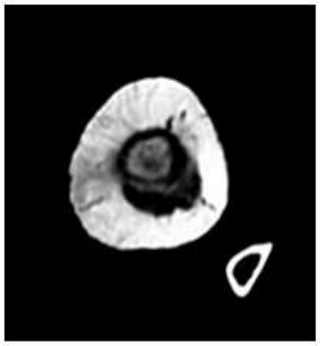
g

(e)Bone scan done during the follow up 3 months later shows no obvious uptake in the region of ablated zone
(f,g)Sagittal and Coronal CEMR images shows no obvious enhancement within the lesion.

Lesions within 5 mm of neurologic structures are the main contraindication to treatment. Patients with bleeding diathesis can be treated following correction of the coagulation disorder.

CASE – IV

a



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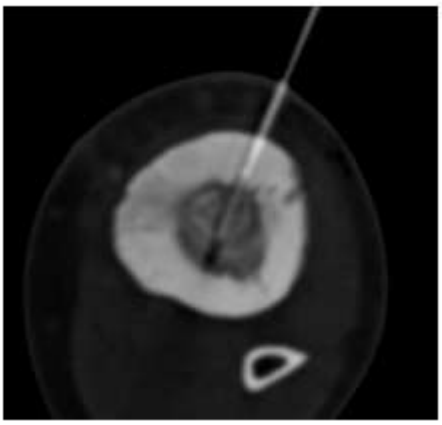

d

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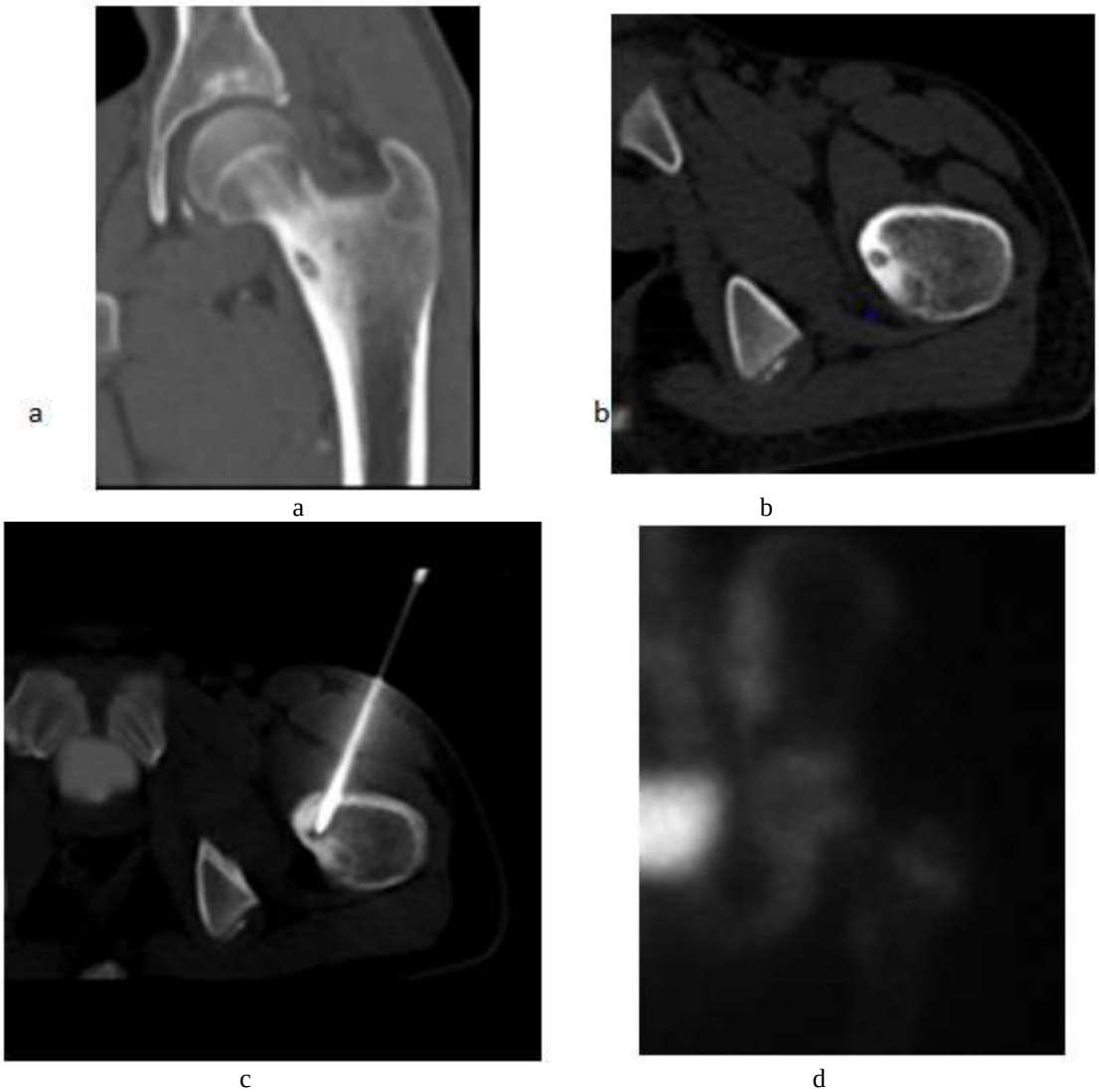
13 year old female ,previously operated for osteoid osteoma presented with recurrent lesion. Follow up imaging revealed-
a & b) Sagittal and axial CT images shows well defined lesion with adjacent sclerosis.
c) Coronal Plain and CEMR images showing avid enhancement of the lesion.
d)Axial CT image Confirming the placement of the ablator needle within the lesion.

CASE – V



a) &b) Coronal and axial Non enhanced CT images showing osteoid osteoma involving the lesser trochanter of femur.
c) Axial CT image Confirming the placement of the ablator needle within the lesion.
d) Follow up bone scan done 48 hours post procedure shows decreased uptake in the region of the lesion.

II. RESULTS

Patients were followed up during the immediate post procedure period within 24 – 48 hours. Wound healing and pain were assessed after 1 and 2 weeks in the outpatient clinic. Patients were planned for followed up after 3, 6, and 12 months and then yearly, with assessment of clinical symptoms and radiological imaging. In our study the patients evolved with complete resolution of the symptoms and radiological findings until the present .

III. CONCLUSION

RFA of Osteoid osteoma should be considered in the first line curative treatment of

osteoid osteoma.It is relatively low cost and minimally invasive, with high success rates and low recurrences.

Success and recurrence rates of CT-guided RF ablation are at least equivalent to those of conventional surgical excision methods, with lower complication rates, a shorter time of hospitalization, and faster recovery.

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