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MINIMAL INVASION, MAXIMUM EFFECT WITH RADIOFREQUENCY ABLATION IN TYPICAL AND ATYPICAL OSTEOID OSTEOMAS.

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Abstract: Osteoid osteomas are common benign bone tumors. Osteoid osteoma commonly affects the diaphysis or metaphysis of long bones in the lower limb. Clinical presentation includes night pain with impairment of quality of life leading to sleep deprivation and relief on NSAIDs. During the last 30 years, RFA has replaced the surgical treatment due to its safety and effectiveness and became the gold standard for the treatment of osteoid osteomas.

Methods: Study was conducted in 33 patients from 1st December 2020 to 30th April 2024. Patients with symptoms like night pain, limping and restricted movements were evaluated with radiograph, CT scan and MRI. All patients of osteoid osteoma were treated with RFA under CT guidance.

Nidus of Osteoid osteomas was approached by drilling the track by 11 G needle followed by access with RFA electrode with ablation tip of 0.5-1cm. The nidus was ablated by heating with RF energy for 5-6 min at 90° C under sedation and spinal anesthesia for lower limb osteoid osteoma.

Results: Out of 33 patients, 21 (63.6%) patients were males, 12 (36.4%) females, with minimum age 6 years and maximum age 38 years. Mean Age of patients was 15.6363. Minimum size of nidus of osteoid osteoma was 3 mm and maximum was 7.20 mm with mean 4.95mm ± 1.01 mm. Mean VAS score pre procedure was 7.88 ± 0.485. At one month follow up VAS score was 1 ± 0.32 and at 1 year was 0.5 ± 0.23. The average hospitalization period was 1.5 day. Technical success was achieved in all patients, with intranidal localization of the needle and complete ablation. Successful pain relief was achieved in all patients within 48 hours. 3 patients (9.1%) had complications. Major complication (Pathological fracture at ablation site after trivial trauma: 1/33 patient (3%). Minor complication (Superficial skin burn): 2/33 Patients (6.1%).

None of the patient had a recurrence of osteoid osteoma at the site of ablation. Thus, success rate of ablation was 100% (Clinical success rate).

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Conclusion: Percutaneous minimal invasive treatment with RFA with 100 % clinical success obviates the need of an open surgery, has less hospital stay, early recovery with better cosmetic outcomes and less complication as compared to open surgeries and has now become the gold standard option due to its targeted approach and high precision.

Keywords. Typical Osteoid osteoma, Atypical Osteoid osteoma, Radiofrequency Ablation.

1. INTRODUCTION

Osteoid osteoma (OO) is a benign bone tumour commonly seen in young age. It is composed of a central nidus surrounded by osteoblasts and peripheral reactive zone of thickened cortical or trabecular bone and loose fibro vascular tissue.[1] It is more frequent in male, usually in young adults.[2] Osteoid osteoma may be present at epiphysis, metaphysis, or diaphysis, and may involve the cortex or cancellous bone. It is common in appendicular skeleton, Femur being the most common bone. Rarely osteoid osteoma can occur at any bone of the body and called as atypical location. Growth disturbance, scoliosis, osteoarthritis, synovitis, restricted movement, and contracture are rare manifestations when it is located at atypical sites. [3 4]

The traditional treatment of osteoid osteoma consists of surgical en bloc excision. This standard method has problems like longer surgery duration and hospital stays, weakening of the bone that needs a preventative fixation and more time missed from school because of open surgery. RFA,[5] laser photocoagulation,[6] and percutaneous resection[7] are some examples of minimally invasive methods that have been suggested as alternatives to surgery that doesn't involve surgery.

NSAIDs are used for pain management. In case of persistence of pain by conservative management surgical resection was considered the definitive treatment in past. Surgical resection faced challenges in lesion localization and resection of the exact lesion. In current era Radiofrequency ablation (RFA) is the gold standard for treatment of osteoid osteoma. It has been found to be a safe, fast, accurate and reliable method of treating osteoid osteomas.[8,9,10]

Computed Tomography (CT) is the method of choice to confirm the diagnosis. The classic radiographic appearance is a small central radiolucent nidus surrounded by a zone of bony sclerosis and cortical thickening caused by endosteal and subperiosteal new bone formation.[11]

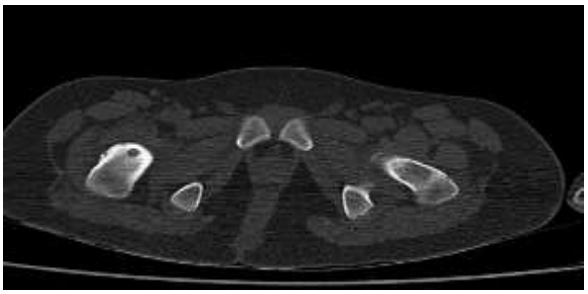

Fig 1: Axial CT scan shows a well-defined nidus with surrounding sclerosis in greater trochanter of right femur.

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The present study was conducted to describe efficacy of RFA in treatment of Typical and Atypical osteoid osteoma.

2. MATERIALS AND METHODS.

A retrospective study was conducted in 33 patients. 21 male, 12 female, age ranging from 3–38 years from 1st December 2020- 30th April 2024, in Pulse clinic and hospital Nagpur after ethical committee approval. Patients were evaluated with radiograph, CT scan and MRI. Inclusion criteria was Classical radiological appearance and symptoms of osteoid osteoma. Exclusion criteria was Non-classical radiological appearance of osteoid osteoma.
Patients with classical radiological appearance of osteoid osteoma were treated with radiofrequency ablation. Visual analogue scale (VAS) for numeric pain score was recorded at presentation and during subsequent follow up for 1 year.
Following instruments were used for ablation.

- RF generator (RF Medical ablation system).
- RF Ablation electrode (Ablating tip of 0.5-1cm).
- RF cooling system.
- Grounding pads.
- CT guidance.
- Bone access: Arrow Oncontrol bone access device (11G, 10 cm).

Fig. 2: RF generator.

Fig.3: RF cooling system.

Fig. 4: RF ablation electrode.

Fig. 5: Bone access device.

Pre-procedure
Detailed examination, that is radiological and blood investigations (CBC,HIV, HBS-AG, HCV, Blood glucose, coagulation profile) were done. Severity of pain was accessed using VAS score. Fitness for sedation was obtained from anaesthetist. Adequate counselling of patient and family was done including possible outcomes and complications.
Patients were advised 6 hours of nil by mouth prior to procedure.
Informed Consent was obtained.
Spinal anaesthesia was used for lower limb osteoid osteoma and sedation was used for osteoid osteoma elsewhere in body.

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Procedure

Procedure was performed under CT guidance. Proper sterilization of site was done. Grounding pads were applied for dispersion of current and Good contact with skin was determined. Lesion was localized under CT guidance. Percutaneously the lesion was approached by drilling in bone with arrow oncontrol bone access device and track was created. RF electrode with ablation tip of 0.5 to 1 cm was then negotiated in the nidus under imaging guidance. Nidus was heated at 90^0 C for 5 minutes. RF electrode was removed. Post ablation CT scan was taken. Sterile dressing was applied at site.

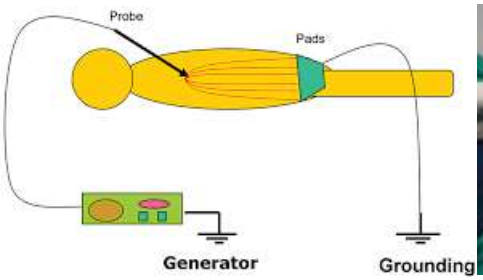

Fig. 6: Application of grounding pads.

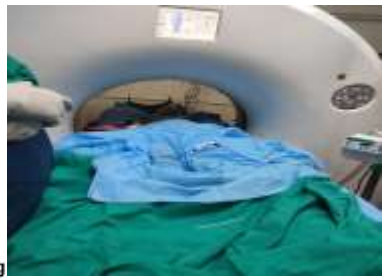

Fig. 7: Patient position and RF electrode placement under CT Scan guidance.

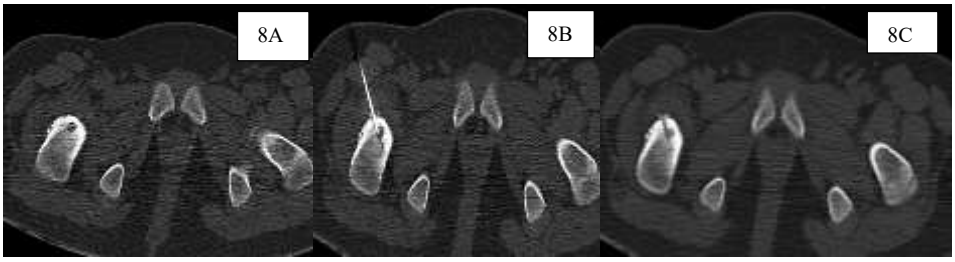

Fig. 8 A: Axial CT scan of 10 year male demonstrating osteoid osteoma in Greater trochanter of right femur.

Fig 8 B: CT guided access into nidus of osteoid osteoma with RF electrode.

Fig. 8 C: Post RF Ablation track.

Fig. 9. A: Axial CT scan of 16 year Female demonstrating osteoid osteoma in Patella.

Fig 9.B: CT guided access into nidus of osteoid osteoma with RF electrode.

Fig. 9 C: Post RF Ablation track.

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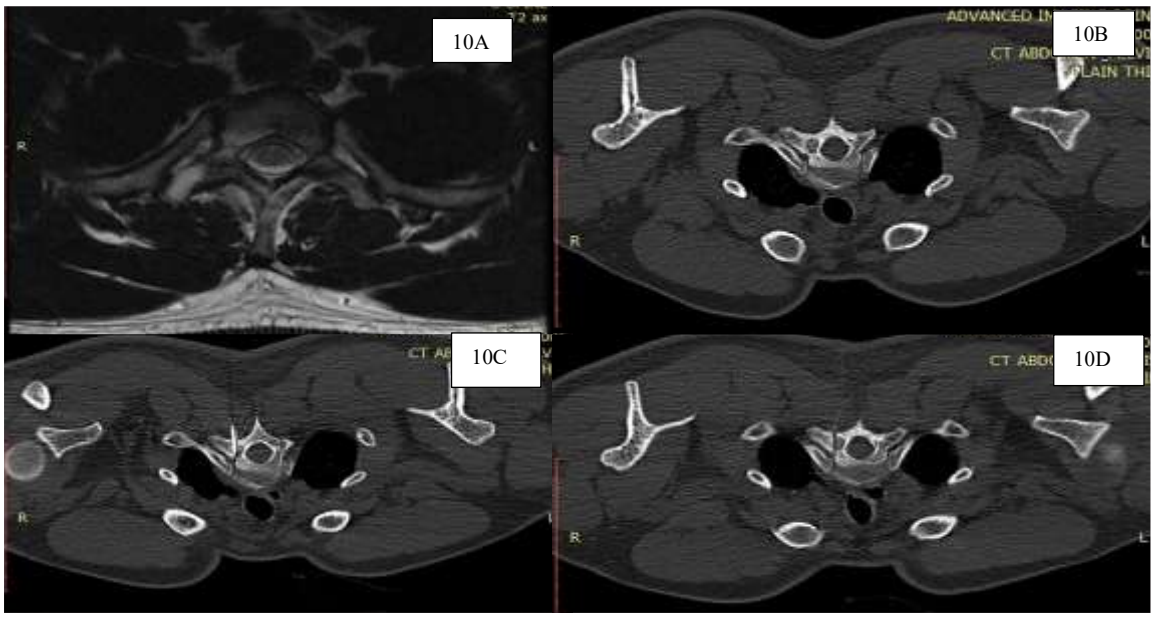

Fig. 10. A and B: Axial MRI and CT of 22 year Male, respectively demonstrating osteoid osteoma in pedicle of vertebra.
Fig 10 C: CT Guided access into nidus of osteoid osteoma with RF electrode.
Fig. 10 D: Post RF Ablation track.

Post procedure care.

All the patients were monitored. Post procedure antibiotics and analgesic were given to patient. Next day the patients were discharged. All the patients were counselled and were refrained from rigorous activity for 1 month with continuation of daily physical activity.

Follow up.

All the patients were followed up for 1 year, Either through examination or with telephonic conversation. Their pain score (VAS) was again assessed during Follow up.

Technical success
It was defined as obtaining the appropriate access of nidus with RF electrode.

Clinical outcomes.
Clinical success was defined as VAS score of 1 or less

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Results

Table 1: Demographic data of the study.

Number of patients.	**33**
Males.	21 (63.6%)
Females.	12 (36.4%)
Most common symptom.	Night pain.
Number of lesions.	34 (1 patient had dual osteoid osteoma)
Cortical lesions.	33 (97.05%)
Medullary lesion.	1 (2.94%)
Most common location of osteoid osteoma in current study.	Proximal femur (43%).
Lesion at Typical site.	84.85%
Lesion at Atypical site.	15.15 %
Most common age group in current study.	11-20 years.
Mean Size of Nidus	$4.95 \pm 1.01\ mm$

Table 2: Study outcome of the study.

Clinical success rate (Patients were followed up for 1 year and all patients had resolution of pain).	**100%**
Major complication (Pathological fracture at ablation site after trivial trauma, 15 days post RFA ablation, Managed surgically).	1/33 patient (3%)
Minor complication (Superficial skin burn, Resolved in 3 months duration).	2/33 Patients (6.1%)
Relapse of osteoid osteoma after RFA.	**0%**
Mean VAS score on presentation	7.88 ± 0.485
Mean VAS score at 1 month Follow up	1 ± 0.32
Mean VAS score at 1 year Follow up	0.5 ± 0.23

Table 3: Anatomical Location of osteoid osteoma.

	Percentage
Proximal femur	48.49%
Midshaft femur	15.15%
Distal shaft femur	6.06%
Proximal shaft of tibia.	9.09%
Mid shaft tibia	3.03%
Mid shaft of left radius	3.03%
Articular process and pars of D2 vertebra (Atypical site).	3.03%
Patella (Atypical site).	3.03%
Pedicle of D5 vertebra (Atypical site).	3.03%
Left great toe (Atypical site).	3.03%
Left calcaneum (Atypical site).	3.03%
Total	**100%**

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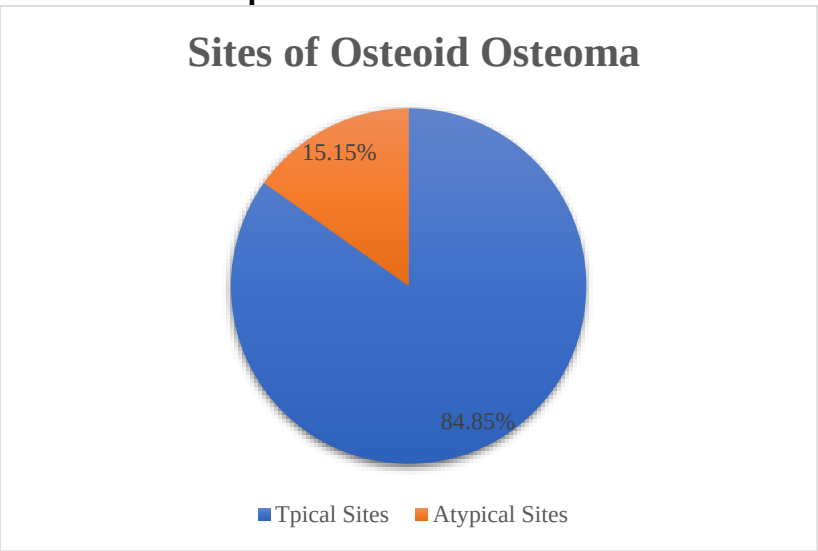
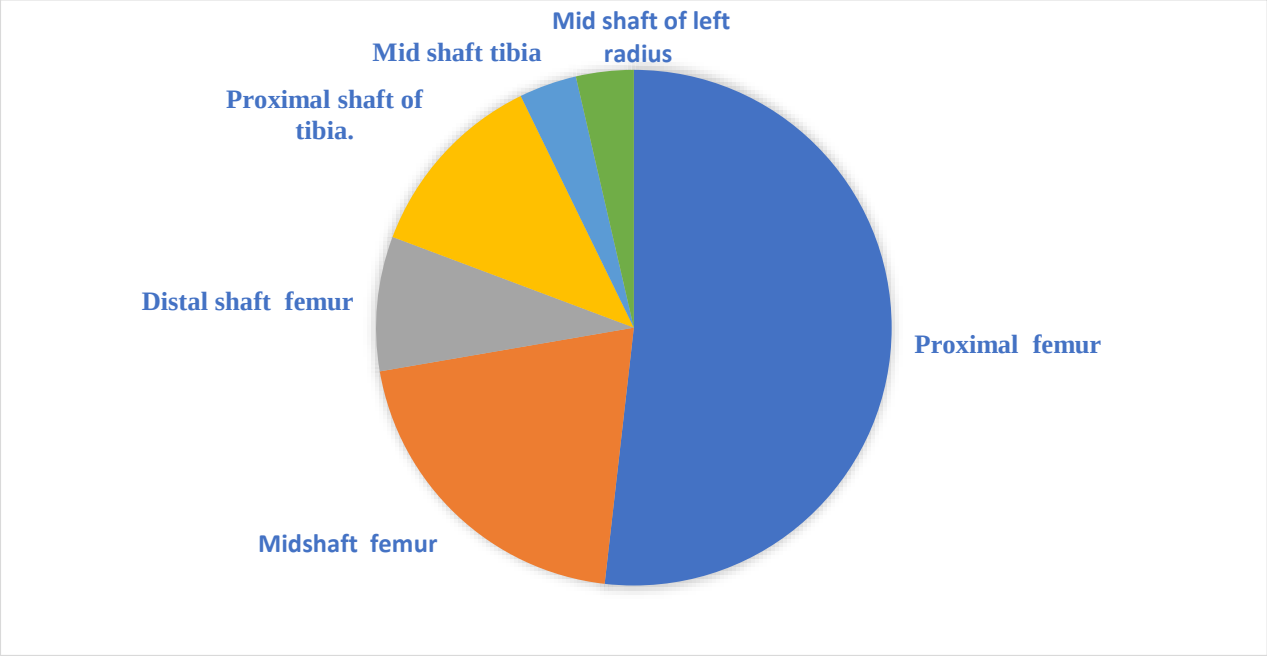
Graph 1: Sites of osteoid osteoma.



Graph 2: Typical sites of osteoid osteoma.



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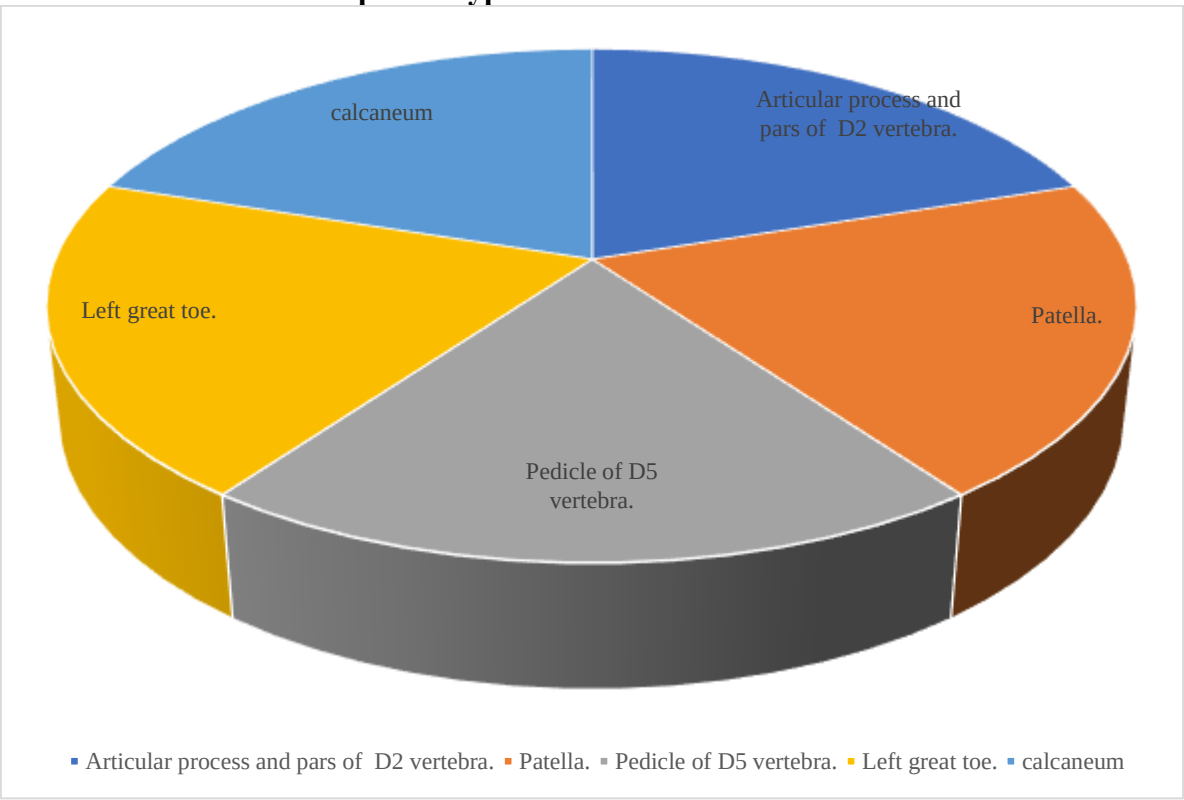
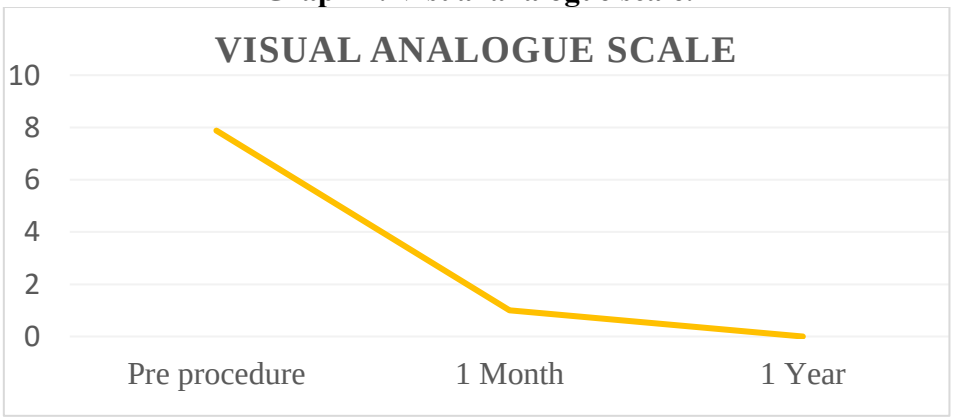
Graph 3: Atypical sites of osteoid osteoma.



Graph 4: Visual analogue scale.



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3. DISCUSSION

In this retrospective study of CT guided radiofrequency ablation of osteoid osteoma, 33 patients were studied, 21 males, 12 females with male to female ratio of 1.75. Osteoid osteoma was more common in males as compared to females. In a study done by Venbrux et al and Resnik D et al similar observation were noted.[12] [13] Osteoid osteoma is commonly seen in children and young adults[14]. In this study most common age group was 11-20 years. Most common location of osteoid osteoma in the study was in lower extremity that is proximal femur, followed by mid shaft of femur which was similar to study conducted by Shanmugasundaram et al. [15] 15.15% patient had osteoid osteoma at atypical sites.

In this study there were good short term and long term outcomes and significant improvement in quality of life. Technical and Clinical success rate was 100%. None of the patients had recurrence of osteoid osteoma at the site of ablation. A systematic review and meta-analysis was done by Shanmugasundaram et al. with different ablative techniques in which they evaluated a total of 1528 patients who underwent various ablative treatments for osteoid osteomas including RFA, MicroWave Ablation (MWA), CryoAblation (CA) and Laser ablation.[16] Majority patients were treated by RFA (n = 1133). The technical success rate was ranging from 84% to 97.8% and clinical success rate from 94.2% to 100%. The rate of recurrence ranged from 0% to 5.79%. A study was done by Lindquester et al. comparing RFA and CA which showed similar results in both modalities.[17] Both studies demonstrated high efficacy and safety of ablation for osteoid osteomas, irrespective of type of ablative treatment chosen. In a study done by Donkol et al,[18] on the efficacy of RFA of osteoid osteoma in children showed that the technical success and primary clinical success rates were 91.3% and 78.2% respectively.

Complications during RFA includes infections, burns, hematomas, fracture of materials for example needles or drills,[19] fractures of bones, injuries of adjacent blood vessels or nerves.[20] In our study, 3 patients (9.1%) had complications, 1 Patient (3%) had pathological fracture at the site of ablation 15 days after the procedure due to trivial trauma which was managed by surgery, 2 patients (6.1%) had complications in form of superficial skin burns which were managed medically. Similar complication rate were seen in study conducted by Shanmugasundaram et al. Sangiorgio et al. in their study proved that RFA has a lower complication rate of 4.4% in comparison to surgical excision with 7.8%. Though, the recurrence rate was slightly higher in the RFA group, that is 6.7%.[21]
Percutaneous CT-guided curettage of osteoid osteoma is a bit more traumatic, and has problems like neuropraxia, skin abrasions, damage to blood vessels, especially in the femur, which can lead to avascular necrosis, and often not enough curettage is done.[22]
RFA being percutaneous local ablation therapy has very short hospitalization length with early recovery and prevents damage to surrounding soft tissue and less complications in comparison to surgical treatments, like an enbloc resection for the osteoid osteoma. In our patient average hospitalization was 1.5 days, which was similar to other studies conducted by D Schmidt et al and Shahram Akhlaghpoor et al .[23,24] Yu et al. had compared percutaneous CT-guided RFA with operative treatment for spinal osteoid osteomas in 28 patients[25] which also showed that treatment with RFA took less time as compared to surgery and that the patients treated by RFA had minimal blood loss and significantly short hospitalization time, complication rate was also lower in the RFA group compared to the surgical group.
RFA is widely accepted, best and minimal invasive method to treat osteoid osteomas. [26,27,28,29]

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4. CONCLUSION

Percutaneous minimal invasive treatment with RFA with 100 % clinical success obviates the need of an open surgery, has less hospital stay, early recovery with better cosmetic outcomes and less complications as compared to open surgeries and has now become the gold standard option due to its targeted approach and high precision.

Conflicts of Interest
None

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