

Original Article

Clinical Outcomes of Percutaneous Ablative Therapy for Osteoid Osteoma in a Tertiary Care Hospital of Low-Middle Income Country (LMIC).*Muhammad Ibrahim¹, Wasif Farman¹, Aman Nawaz¹, Zeeshan Khan¹**1.Rehman Medical Institute*

Introduction: Osteoid osteoma (OO) is a benign bone tumour producing intense pain due to high levels of prostaglandins. Various treatment options exist for its management including the use of non-steroidal anti-inflammatory drugs, surgical excision and minimal invasive percutaneous ablation with radiofrequency ablation (RFA) or Microwave ablation (MWA).

Objective: The purpose of this study was to determine the clinical outcomes of OO treated with percutaneous ablation using RFA and MWA techniques by determining their clinical and technical success.

Methodology: This retrospective case series was performed at Rehman medical institute, Peshawar, Pakistan from July 2017 till August 2023. All patients presenting with OO diagnosed on imaging, no prior surgical treatment for the lesion, amenable to percutaneous ablation technique with a minimum of 12 months' follow-up post procedure, were included in the study. All the patients had grading of pain, pre and post treatment with visual analogue scale (VAS) and complications both pre and post operatively were recorded along with a minimal follow up of 12 months along with need for any further surgical treatment.

Results: In total 9 cases were included in this study, with only one being female and a mean age for the sample size was 21 years (SD=5). The mean pretreatment VAS score of the cohort was 7.4 (SD=1.7). In all the cases 100% technical success was achieved. Most of the patients reported no pain at 12-month follow-up and only 2 reported mild residual discomfort (VAS 1) at 1-year follow-up. One patient had recurrence with RFA and was subsequently treated with MWA with no further recurrence with a reported success rate for the whole cohort as 87.5%.

Conclusion: In conclusion, this study confirms that CT-guided percutaneous ablative technique is a minimally invasive, reliable and safely reproducible technique for the management of OO.

Keywords: Osteoid Osteoma, Interventional radiography, Radiofrequency ablation, Microwave ablation.

How to cite: Ibrahim M, Farman W, Nawaz A, Khan Z. Clinical Outcomes of Percutaneous Ablative Therapy for Osteoid Osteoma in a Tertiary Care Hospital of Low-Middle Income Country (LMIC). (JBSS). 2026; 01(01): 1-10

Corresponding Author: Muhammad Ibrahim, ibrahim9996@gmail.com

Introduction:

Osteoid osteoma (OO) is a benign bone tumour first reported by Jaffe, in 1935¹. It accounts for 11-14% of all benign bone tumors² and 2-3% of all primary bone tumors³. OO presents in patients from 5 to 30 years of age with the majority younger than 20 years of age³.

Additionally, it shows a male predominance with a ratio of 2-3:1⁴. OO predominantly presents in the appendicular skeleton. Incidence of presentation of OO in the axial skeleton is rare; with 6-20% of them presenting in the spine and that too in posterior elements of the spine. In the appendicular skeleton, its presentation is

common in lower limbs with the highest percentage in the tibia. In the upper limbs, its highest presentation is in the humerus followed by radius and ulna⁵. Patients with OO present with complaints of intense pain and seldom produces any deformity or a palpable swelling. The pain is usually severe at night; the pathophysiology behind it is that the tumour produces prostaglandins which is also why they respond well to NSAIDS⁶.

Usually, it's a self-limiting disease but for the tumour to heal completely it takes a long time, usually many years⁷. OO can be managed both conservatively and with surgery. Conservative treatment involves using NSAIDs which not only helps in alleviating pain but may help in shortening the duration of the tumours to heal⁸. However, long-term use of NSAIDs exposes patients to other side effects like GI disturbances and renal toxicity⁹.

Open surgical excision of OO or Percutaneous ablation are the two main surgical treatment methods. Open surgical excision offers the advantage of complete excision of the lesion, however, the downside is increased surgical morbidity, large residual osseous defect which may or may not need bone grafting and stabilization along with inadequate excision and increased post op recovery time^{10, 11}. However, recently percutaneous ablation has gained popularity because it is CT guided which enhances precise targeting of the tumour nidus, reduces morbidity and length of stay in hospital and early return to work¹².

D. Rosenthal first described the use of radiofrequency as a modality of percutaneous ablation, and since then, percutaneous ablation has become the 'gold standard treatment' for OO¹³. RFA cause local tumour necrosis by resistive electro-thermal effects and have been proven to be an efficient and safe way of treating OO¹⁴. In this procedure, a needle is placed in the lesion under CT guidance and a high-frequency electrical current is passed through an electrode in the needle generating heat in that small area. The heat then induces coagulation necrosis of all the tissue around the electrode¹². Lanza analysed 27 articles consisting of 1,772 patients with osteoid osteoma treated with RFA and found a success

rate of 95%¹⁵. Cryoablation is another method of percutaneous ablation and has also found a 95.2% success rate. In cryoablation, a cryoprobe is inserted in the tumour CT-guided and it induces regular cycles of freezing and thawing with a temp below -40c essentially freezing the tumour to death¹⁶. It has very good short-term results but in contrast, long-term results show a 90% success rate¹⁷. Microwave ablation first described in 2014, uses, as the name suggests, microwaves for the tumour ablation. Microwave ablation has a few advantages over RFA including a faster heating rate, a higher intra-tumour temperature and a larger ablation area¹⁸. Percutaneous ablation has its disadvantages as well, albeit minimal, it can lead to nerve damage especially if the nerve is within 1cm of the probe, recurrence has also been noted in lesions that are larger than 1cm in size¹⁹.

Despite the established role of CT-guided RFA in effectively treating OO, treatment failure (TF) has been reported in almost 5% of the cases. These patients are those who either responded differently or did not respond at all. Literature has attributed this treatment failure to multiple factors such as ablation time, age or location of the tumor¹⁵. Technical success is another outcome measurement tool of percutaneous ablation therapy which is defined as a completed RFA session including correct placement of the probe within the nidus with the border not exceeding the active tip by more than 5mm²⁰.

The purpose of this study was to determine the clinical outcomes of OO treated with percutaneous ablation using RFA and MWA techniques by determining their clinical and technical success.

Methodology:

Data for this retrospective case series was collected from a prospectively held data base at the senior authors primary institution and all the patients undergoing percutaneous ablation either with RFA or MWA for OO were included in this study after application of the inclusion criteria which consisted of patients who had a typical OO diagnosed on plain radiographs and CT, had no prior surgical treatment for the

lesion, the lesion was accessible for the percutaneous technique and had minimum 12 months follow-up. Procedural consent was taken from the patient before surgery and Ethical Approval was taken from the Institute's Ethical Approval Committee(RMI/RMI-REC/Article Approval/99). All the patients had pre-treatment visual analogue scoring for pain and at a minimum of 12 months post treatment for the purpose of this study. Per operative technical success, clinical outcome were determined as our primary outcomes and any complications were recorded as our secondary outcomes. Data was collected on Excel sheets and analysed for results.

All patients underwent pre-procedure CT for planning. All the procedures were performed under general anaesthesia (GA) except the first one which was first operated under local anaesthesia and conscious sedation. The procedure was repeated for this patient under GA due to incomplete ablation. Location was marked with CT guidance, after GA. The track for the RFA or MWA needle was made by the senior author via a 4.5 mm bone drill. Access to the nidus was confirmed on check CT. An ablation probe was placed across nidus, and the position was confirmed with CT. The nidus is ablated according to standards set by the manufacturer's manual. We used Soloist (Boston Scientific) single-electrode probe in RFA. Maximum of 6 watts was used with an average burn time of 20 minutes at 3 stations. ECO Microwave system was used in MWA. A maximum of 30 watts was used for 1 minute. The total average burn time was 2.5 minutes at 4 cycles, each cycle of 30 seconds to 1 minute. All patients had post-operative analgesia as per requirement and 1 dose of prophylactic antibiotic cover (1.5 gm Cefuroxime) and follow-up for minimum of 12 months. Upon follow-up, patients' VAS scores were recorded and x-rays were done to determine consolidation of the tumour and clinical success based on patient's symptoms getting better.

Results:

A total of 9 patients who underwent RFA or MWA for OO and eligible for inclusion in the study were evaluated. Out of 9, only one patient was female. The mean age of our cohort was 21

years(SD=5). Out of the total, 4(44.4%) patients presented with an osteoid osteoma in the tibia, 4(44.4%) in femur and 1(11.11%) in the acetabulum(Table 1). The mean pre-treatment VAS score for pain of our group was 7.4 (SD=1.7). The average duration of symptoms among our group was 14 months (SD=5.2) and all of them were taking regular NSAIDS for pain relief. Six lesions were treated with microwave ablation (MWA) and four with radiofrequency ablation (RFA); one of the RFA-treated lesions later required retreatment using MWA. Nine procedures were done under general plus local anaesthesia and one case was done under local and conscious sedation. Most of the patients were discharged post-session either as day-case or the next morning, except 2 who stayed beyond 24 hours for pain management. Biopsy specimens were also sent for histopathological examination of all the cases and they confirmed our diagnosis of OO. In all cases we were able to access the nidus and were able to achieve the standards set for ablation, thus achieving 100% technical success.

Most of the patients reported no pain at 6-month follow-up and only 2 reported mild residual discomfort (Mean VAS 0.2) at 1-year follow-up. There was a significant reduction in pain at last follow-up with the mean difference of -7.2. One patient with the talus Osteoid Osteoma had developed superficial skin infection post-operatively which was treated with broad-spectrum antibiotics, one patient had recurrence with RFA and was subsequently treated with MWA. Our study reports this one recurrence as Treatment failure with otherwise 87.5% clinical success.

Discussion:

OO is a benign bone lesion that usually is found in the lower limb bone cortices. These lesions have long been treated via an open surgical approach but recently percutaneous ablative techniques have become the mainstay of treatment where accessible. The reasons for favouring percutaneous technique are minimal surgical morbidity, shorter hospital stay, better tumour targeting as it is CT-guided and faster post-operative recovery. Although RFA is the most favoured modality of percutaneous

ablation, MWA and cryoablation have also shown satisfactory results. Even though percutaneous ablation has established its role in treating OO it still results in treatment failures in almost 5% of the cases. This has been attributed to difficult-to-reach locations of the tumour or the duration of the ablation time.

OO presents mostly in the long bones of the appendicular skeleton. The femur is the most common location followed by the tibia and humerus²¹. Our patients had a similar presentation with all of the patients presenting with a lesion in their appendicular skeleton, long bones being affected more frequently. The predominant symptom of patients is pain due to the higher production of prostaglandins by the nidus of an Osteoid Osteoma. Hence, these patients also respond well to NSAIDs²². During our sub-group analysis, it was discovered that our patients had an average of 14 months (SD=5.2) of duration of symptoms and almost all of them were on different types of NSAIDs further increasing their risk of GI and renal disturbances for a disease which can very easily be treated with a percutaneous day case procedure.

The predominant symptom of pain is variable in intensity, localized and mostly gets worse by nightfall. According to the Visual analogue score, most of these patient pain is at the intensity level of 7.5, on average, when they first present to their surgeon²³. This level of pain can be incapacitating and affects the daily life activities of these patients. During the pre-operative assessment of our patients, it was determined that they also presented with pain with a VAS score of 7.4(SD=1.7) on average. After the procedure, their pain got better which was evident through their short and mid-term VAS scores on follow-up. Most of the patients reported no pain at the 6-month follow-up and only 2 reported mild residual discomfort (VAS 1) at the 1-year follow-up.

The percutaneous ablative technique has become the gold standard in treating Osteoid Osteoma not only because of lesser morbidity, day case procedure but also because it has produced very good results as evident in the literature¹². Many authors have evaluated this technique's outcomes by technical success and

treatment failure²³. Lindquester, in their systematic review reported a technical success of 97% and a clinical success of 97.9%¹². Among our patients, we achieved 100% technical success with only 1 case of treatment failure. This patient was initially ablated with radiofrequency, but his symptoms recurred. In his second session, we used a microwave ablative probe to successfully treat his lesion. The patient was symptom-free at 6-month and 1-year follow-up visits.

The only limitations of this treatment modality are the availability of logistics and trained medical personnel who can perform these procedures, especially in a resource constrained country like ours. Financial implications of this procedure are also a concern particularly in the lower middle income group countries (LMIC). But when cumulative analysis of financial implications of RFA or MWA are made with open procedures also keeping in view the length of stay in hospital, medications and time off work, they are equal. Goksel, in their comparative analysis, stated that RFA, in comparison with surgical curettage, takes less time and a shorter hospital stay, thus proving to be a more cost-effective alternative²⁴.

Limitations of this study are a small sample size with no comparator group, selection bias and only a short to mid-term follow-up. We would therefore suggest long term multi centre comparative studies for larger sample size capture.

Conclusion:

In conclusion, this study confirms that the CT-guided percutaneous ablative technique is a safe and effective procedure with satisfactory results in the management of OO. Being percutaneous and augmented with CT, it confirms the exact location of the tumor resulting in lesser local morbidity, hospital stay and faster post-operative recovery. We recommend that this procedure should be offered to all the patients with OO, where indicated, with its merits and demerits explained.

Figure 1: CT images showing a right femoral calcar Osteoid Osteoma(a); drill used to make a tunnel(b), (c) probe inserted inside the lesion for ablation, (d) Post-ablation image confirms the tract placement and the successful ablation of the lesion.

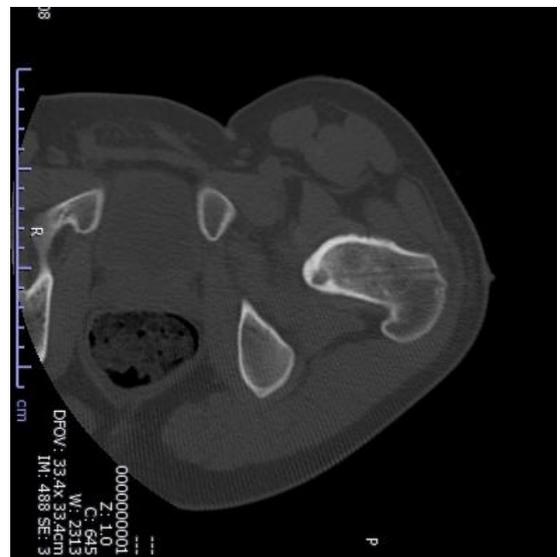
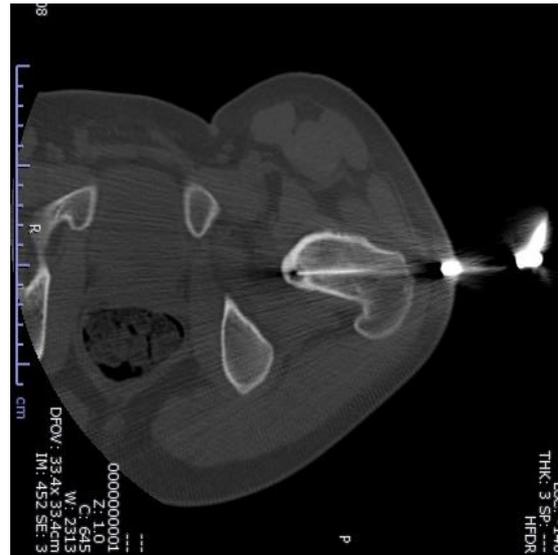
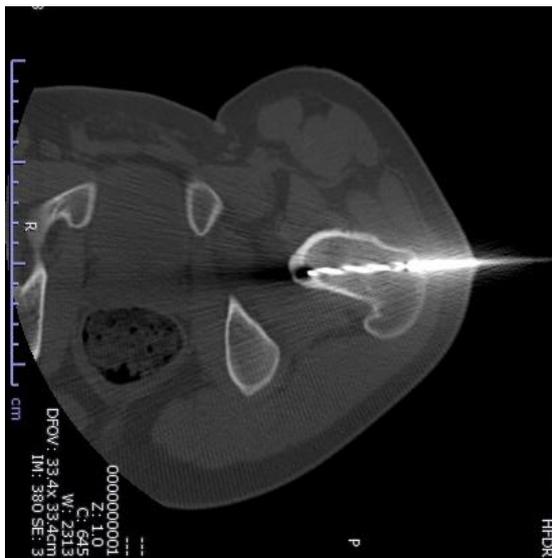
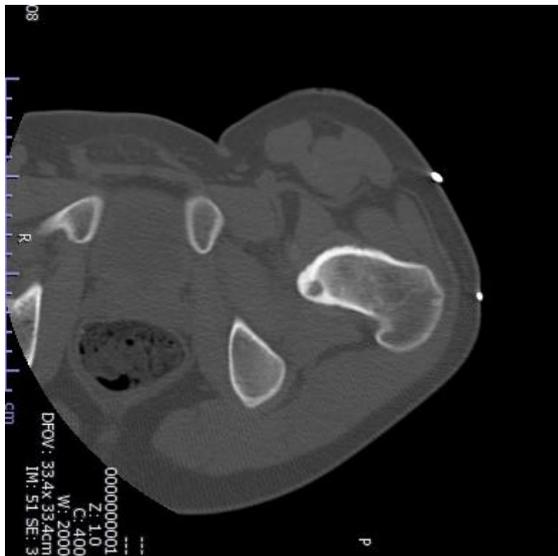


Figure 2: CT images showing an Osteoid Osteoma of posterior cortex of a Tibia(a); drill used to make a tunnel(b), (c) probe inserted inside the lesion for ablation, (d) Post-ablation image confirms the tract placement and the successful ablation of the lesion.

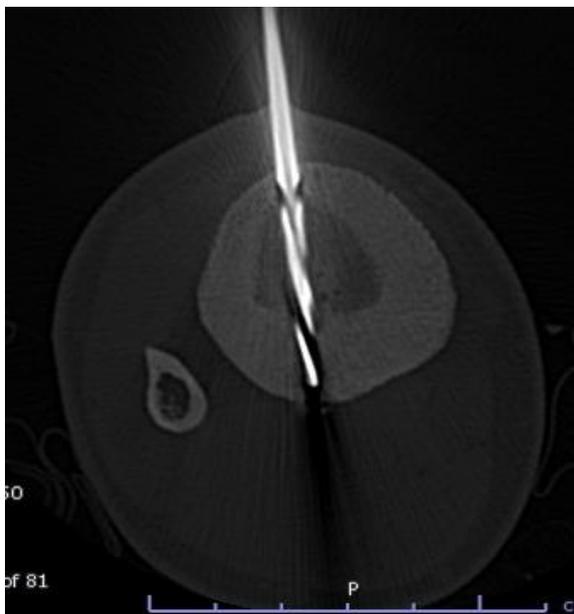


Table 1

Patient demographics and baseline characteristics

Characteristic	n=9
Age (years)	21 (SD±5)
Gender	
Male	8
Female	1
Location of OO	
Tibia	4(44.4%)
Femur	4(44.4%)
Acetabulum	1(11.11%)
Duration of symptoms (Average)	14.2Months (SD±5.2)
Pre-operative VAS	7.4 (SD±1.7).
Post-operative VAS	0.2
Technical Success	100%
Clinical Success	87.5%
Complications (Recurrence)	1

References:

1. JAFFE HL. "OSTEOID-OSTEOMA": A BENIGN OSTEOBLASTIC TUMOR COMPOSED OF OSTEOID AND ATYPICAL BONE. Archives of Surgery. 1935;31(5):709-28.
2. De Filippo M, Russo U, Papapietro VR, Ceccarelli F, Pogliacomini F, Vailenti E, Piccolo C, Capasso R, Sica A, Cioce F, Carbone M, Bruno F, Masciocchi C, Miele V. Radiofrequency ablation of osteoid osteoma. Acta Biomed. 2018;89(1-s):175-85.
3. Zhang Y, Rosenberg AE. Bone-forming tumors. Surgical pathology clinics. 2017;10(3):513-35.
4. Tepelenis K, Skandalakis GP, Papanthanos G, Kefala MA, Kitsouli A,

Barbouti A, Tepelenis N, Varvarousis D, Vlachos K, Kanavaros P, Kitsoulis P. Osteoid Osteoma: An Updated Review of Epidemiology, Pathogenesis, Clinical Presentation, Radiological Features, and Treatment Option. In Vivo. 2021;35(4):1929-38.

5. AlQahtani SM, Albadran AA, Altalib A, Hamza WM, Hegazi TM. Osteoid Osteoma of the Proximal Humerus: A Case Report and Literature Review. Saudi J Med Med Sci. 2023;11(2):178-82.
6. Chandwar K, Lathiya H, Gohel A, Shah C. Sacral osteoid osteoma: a rare cause of inflammatory back pain and sacroiliitis in a young man. BMJ Case Reports. 2021;14(8):e244074.
7. Youlden DJ, Mow T, Le M, Guzman MS, Symes M. An uncommon bone tumor in an even more uncommon location: A case of cuboid osteoid osteoma. Foot & Ankle Surgery: Techniques, Reports & Cases. 2022;2(2):100199.
8. Yokouchi M, Nagano S, Shimada H, Nakamura S, Setoguchi T, Kawamura I, Ishidou Y, Komiya S. Early complete remission of osteoid osteoma with conservative medical management. Pediatr Rep. 2014;6(1):5311.
9. Boscainos PJ, Cousins GR, Kulshreshtha R, Oliver TB, Papagelopoulos PJ. Osteoid osteoma. Orthopedics. 2013;36(10):792-800.
10. Çakar M, Esenyel CZ, Seyran M, Tekin A, Adaş M, Bayraktar MK, Coşkun Ü. Osteoid osteoma treated with radiofrequency ablation. Adv Orthop. 2015;2015:807274.
11. Bhure U, Roos JE, Strobel K. Osteoid osteoma: multimodality imaging with focus on hybrid imaging. Eur J Nucl Med Mol Imaging. 2019;46(4):1019-36.

12. Lindquester WS, Crowley J, Hawkins CM. Percutaneous thermal ablation for treatment of osteoid osteoma: a systematic review and analysis. *Skeletal Radiol.* 2020;49(9):1403-11.
13. Rosenthal DI, Alexander A, Rosenberg AE, Springfield D. Ablation of osteoid osteomas with a percutaneously placed electrode: a new procedure. *Radiology.* 1992;183(1):29-33.
14. Shanmugasundaram S, Nadkarni S, Kumar A, Shukla PA. Percutaneous Ablative Therapies for the Management of Osteoid Osteomas: A Systematic Review and Meta-Analysis. *Cardiovasc Intervent Radiol.* 2021;44(5):739-49.
15. Lanza E, Thouvenin Y, Viala P, Sconfienza LM, Poretti D, Cornalba G, Sardanelli F, Cyteval C. Osteoid osteoma treated by percutaneous thermal ablation: when do we fail? A systematic review and guidelines for future reporting. *Cardiovasc Intervent Radiol.* 2014;37(6):1530-9.
16. Pusceddu C, Vergantino E, Santucci D, Marsico S, Cappucci M, Vaccarino F, Beomonte Zobel B, Grasso RF, Faiella E. Percutaneous Cryoablation under Conscious Sedation: A Safe, Effective and Painless Option for the Treatment of Pediatric Osteoid Osteoma. *J Clin Med.* 2023;12(21).
17. Whitmore MJ, Hawkins CM, Prologo JD, Marshall KW, Fabregas JA, Yim DB, Monson D, Oskouei SV, Fletcher ND, Williams RS. Cryoablation of Osteoid Osteoma in the Pediatric and Adolescent Population. *J Vasc Interv Radiol.* 2016;27(2):232-7; quiz 8.
18. Parisot L, Grillet F, Verdot P, Danner A, Brumpt E, Aubry S. CT-guided microwave ablation of osteoid osteoma: Long-term outcome in 28 patients. *Diagnostic and Interventional Imaging.* 2022;103(9):427-32.
19. Singh DK, Kumar N, Rustagi A, Jalan D, Krishna LG, Sharma A. Percutaneous CT-guided radiofrequency ablation of osteoid osteoma: Potential Pitfalls and complications and how to avoid them. *J Clin Orthop Trauma.* 2022;28:101869.
20. Chahal A, Rajalakshmi P, Khan SA, Rastogi S, Srivastava DN, Gamanagatti S. CT-guided percutaneous radiofrequency ablation of osteoid osteoma: Our experience in 87 patients. *Indian J Radiol Imaging.* 2017;27(2):207-15.
21. Tordjman M, Perronne L, Madelin G, Mali RD, Burke C. CT-guided radiofrequency ablation for osteoid osteomas: a systematic review. *Eur Radiol.* 2020;30(11):5952-63.
22. Noordin S, Allana S, Hilal K, Nadeem N, Lakdawala R, Sadruddin A, Uddin N. Osteoid osteoma: Contemporary management. *Orthop Rev (Pavia).* 2018;10(3):7496.
23. Shu M, Ke J. The surgical management of osteoid osteoma: A systematic review. *Front Oncol.* 2022;12:935640.
24. Göksel F, Aycan A, Ermutlu C, Gölge UH, Sarısözen B. COMPARISON OF RADIOFREQUENCY ABLATION AND CURETTAGE IN OSTEOID OSTEOOMA IN CHILDREN. *Acta Ortop Bras.* 2019;27(2):100-3.

Conflict of interest statement/funding information:

Not Applicable.

Author

MI, AN and ZK conceived the idea for the study.

Contributions:

MI, WF and ZK designed the study protocol.



MI conducted the statistical analysis.

MI, WF, AN and ZK were responsible for the initial draft of the report, contributed to subsequent drafts and all authors were involved in the final draft.

ZK was responsible for supervision