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Surgical results in cases of osteoid osteoma: a single-center retrospective study

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ABSTRACT

Aims: Osteoid osteoma is a benign bone tumor with night pain that is initially responsive to salicylates and is characterized by new bone formation. However, it may not always present with typical findings. This study aims to evaluate the clinical, radiological, and histological findings of patients who were treated for osteoid osteoma and discusses the diagnostic stages and surgical results of patients treated for osteoid osteoma.

Methods: A retrospective examination was made of patients treated in the Orthopedics and Traumatology Clinic of the 3rd Step University Hospital and diagnosed with osteoid osteoma between January 2010 and January 2023. The patients' demographic data and clinical, radiological, and histopathological evaluations were recorded.

Results: In the surgical treatment in this study, the nidus was excised with the en-bloc resection method or burr-down-assisted intralesional curettage. In cases where the nidus was completely excised, it was observed that the initial complaints of the patients disappeared completely. In cases where the nidus could not be completely removed, a second surgery was planned, the nidus was removed and the patients' complaints were resolved.

Conclusion: Osteoid osteoma treatment must completely remove the nidus. Treatment options are evaluated according to the anatomical localization of the lesion. Burr-down assisted intralesional curettage is the main treatment principle in cases where the localization is clearly selected by measuring preoperative CT sections.

Keywords: Bone neoplasms, osteoma, osteoid, curettage, treatment outcome

INTRODUCTION

Osteoid osteoma (OO) is a benign, solitary bone lesion of osteoblast origin characterized by bone production. Henry Jaffe made the first definition related to osteoid osteoma in 1935,[1] and currently, osteoid osteoma constitutes approximately 15% of all bone lesions. OO is formed by a nidus formed from osteoids, osteoblasts, and fibrovascular stroma, is an average of 1cm in diameter, the center is radiolucent, and the edges have a sclerotic appearance.[2] This lesion, which is determined most often in males between the ages of 5 and 25 years, is located in the diaphysis and metaphysis of the long bones.[3] In approximately 30% of cases, a lesion is seen in the femur, tibia, spine, pelvis, and smaller carpal and tarsal bones.[2]

Clinically, the most typical symptom is severe pain to wake the patient from sleep at night. This pain responds dramatically to salicylates and non-steroid anti-inflammatory drugs (NSAID). Other than this typical pain, patients may present with different symptoms depending on the localization. For example, when there is superficial localization, findings such as pain on palpation, impaired gait, and muscle atrophy may be seen. In addition to the clinical findings in the diagnosis, the nidus should be shown with radiological imaging. Just as OO can be left for conservative follow-up, there are treatment options of open surgery and computed tomography (CT) -assisted radiofrequency ablation (RFA) procedure.

This study aimed to examine the demographic characteristics, clinical complaints, diagnostic methods, and treatment results of patients who applied surgical treatment to diagnose osteoid osteoma and compare these with literature data.

METHODS

The study included 38 patients with clinical, radiological, and histological findings consistent with osteoid osteoma who were operated on in the orthopedics and traumatology department of medical faculty hospital between January 2010

and January 2023. Patients who did not attend follow-up appointments regularly had incomplete data in the records and were treated with the radiofrequency ablation method, so they were excluded from the study.

Ondokuz Mayıs University Clinical Research Ethics Committee obtained the ethics committee approval with decision no: 2022/258, dated: 27.07.2022. We obtained informed consent forms from all patients for the procedure. The ethical rules and the principles of the Declaration of Helsinki carried out all procedures.

The patient's demographic data and preoperative and postoperative clinical and radiological findings were recorded retrospectively. The patients were evaluated in terms of age, gender, localization of the lesion, complaints on presentation, duration of complaints, and response to oral salicylates and NSAIDs. From the tests applied to the patients, the findings on the plain radiograph (x-rays), computed tomography (CT), magnetic resonance imaging (MRI), and bone scintigraphy were analyzed statistically.

The diagnosis is based on thin-section computerized tomography since misdiagnoses may occur when interpreting the usual tomography sections. The surgical treatment applied to all the patients was en-bloc resection or intralesional curettage with burr-down assistance, and the senior surgeon performed all of the procedures. According to computerized tomography sections, no adjuvant therapy is used following the en-bloc resection since it's a benign bone tumour. Preoperatively, the distance of the lesion is measured according to anatomical landmarks in CT axial, sagittal, and coronal sections. The skin incision is determined with the help of fluoroscopy according to the evaluation of CT measurements.

RESULTS

The evaluation was made of 38 patients operated on for a diagnosis of osteoid osteoma, comprising 20 (52.6%) males and 18 (47.4%) females, with a mean age of 12.5 years (range, 3-36 years). Involvement was seen on the right side in 21 (55.3%) patients and on the left in 17 (44.7%) (Table 1). The most common sites of localization of the lesion were the femur (n.14, 36.8%) and the tibia-fibula (n:9, 23.7%), followed by bones of the hand in 5 (13.1%), bones of the foot in 3 (7.9%), the pelvic bones in 3 (7.9%), the humerus in 2 (5.3%), and the radius in 2 (5.3%). Of the cases with the lesion in the hand, it was in a phalanx in 4 and the os triquetrum in 1. The lesion was in a phalanx in the cases with foot region involvement (Table 2). When asked about the character of the pain, 25 (65.8%) patients described typical pain of osteoid osteoma

Table 1. Demographic data of the patients

Categories	n=38	%
Age (Mean on year)	12,5	
Sex (number of patients)		
Male	20	52.6%
Female	18	47.4%
Admission complaints		
Aspecific pain	5	13.2%
Pain that wakes the patient from sleep at night	25	65.7%
Other complaints	8	21.1%
Responded to oral salicylates and NSAIDs	29	76.3%
Laterality (number of patients)		
Right	21	55.3%
Left	17	44.7%

Table 2. Anatomical localization of 38 patients with osteoid osteoma

Nidus location	n	%
Lower extremity	29/38	%76.3
Femur	14	%36.8
Tibia-Fibula	9	%23.7
Foot	3	%7.9
Pelvis	3	%7.9
Upper extremity	9/38	%23.7
Hand	5	%13.1
Radius	2	%5.3
Humerus	2	%5.3

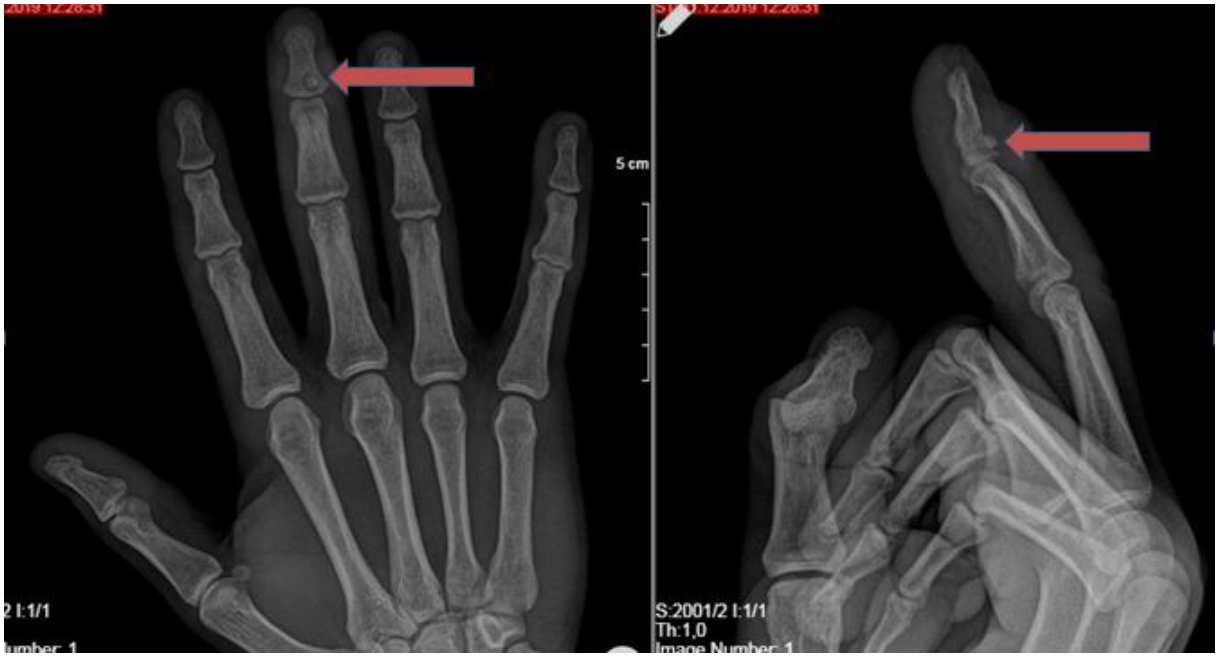

Figure 1. Characteristic direct radiography for osteoid osteoma; radiolucent nidus surrounded by sclerotic bone located in the distal phalanx of the third finger

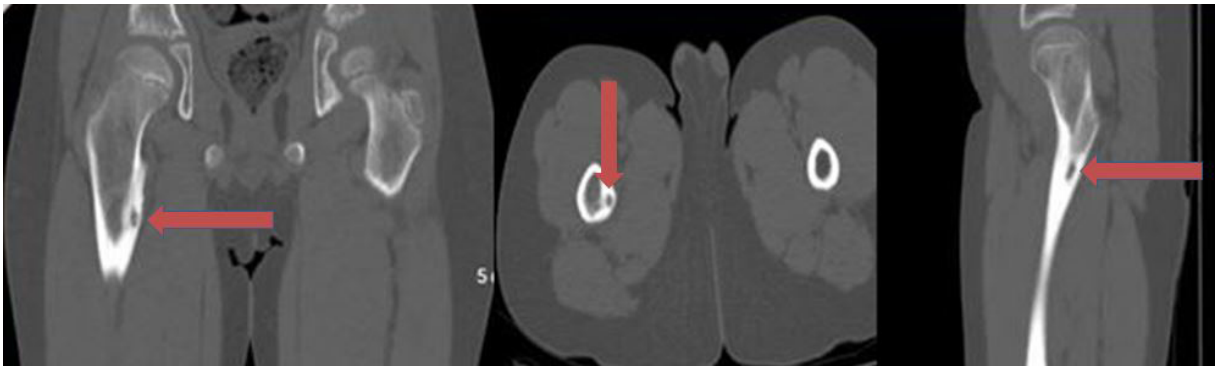

Figure 2. View of the nidus at the level of the right femur trochanter minor detected by computed tomography

that woke them from sleep at night. It was determined that 29 (76.3%) patients responded to oral salicylates and NSAIDs. The mean time from the onset of symptoms to diagnosis was 6.2 months (range 3-40 months).

Plain radiography is the first test required to diagnose OO. Hence, x-rays were obtained for all 38 cases to set the diagnosis of the tumor. The typical appearance on X-ray is of the sclerotic bone surrounding a radiolucent nidus (Figure 1). The method that best visualizes the nidus is computed tomography, so it was determined that 37 patients (97.4%) had CT scans (Figure 2). MRI is less successful in imagining cortical bone, periosteal reaction, and calcifications than CT. It was observed that an MRI was performed on 26 patients (68.4%) (Figure 3). Bone scintigraphy is highly sensitive to the determination of OO localization. The bone scintigraphy images of 19 patients were examined (50 %).

For patients whose pain does not recover with medical treatment, the treatment for OO is surgical excision. Successful treatment is defined as complete surgical excision of the nidus. The currently used surgical methods are curettage, en-bloc (wide) resection, and percutaneous radiofrequency ablation. In the surgical treatment of the 38 patients in this study, the nidus was excised with the en-bloc resection method (Figure 4) or burr-down-assisted intralesional curettage (Figure 5). Burr-down-assisted intralesional curettage was applied to most cases (n: 29). Nidus was excised in 9 cases where preoperative measurement could not determine the nidus localization. With CT, the bone where the nidus is located is completely imaged, and the distance of the lesion to the anatomical landmarks is measured in the coronal, axial, and sagittal planes. The preoperative surgical approach is determined accordingly. Before the skin incision is made, the location of the lesion is determined intraoperatively with direct radiography, and the surgical procedure is performed. Our main surgical technique is burr-down-assisted intralesional curettage. However, en bloc resection was applied to remove the nidus precisely when the localization could not be precisely measured with preoperative CT. While measurement can be easily made with CT in long bones, it may be difficult to precisely determine the location of the nidus in flat and membranous bones. The

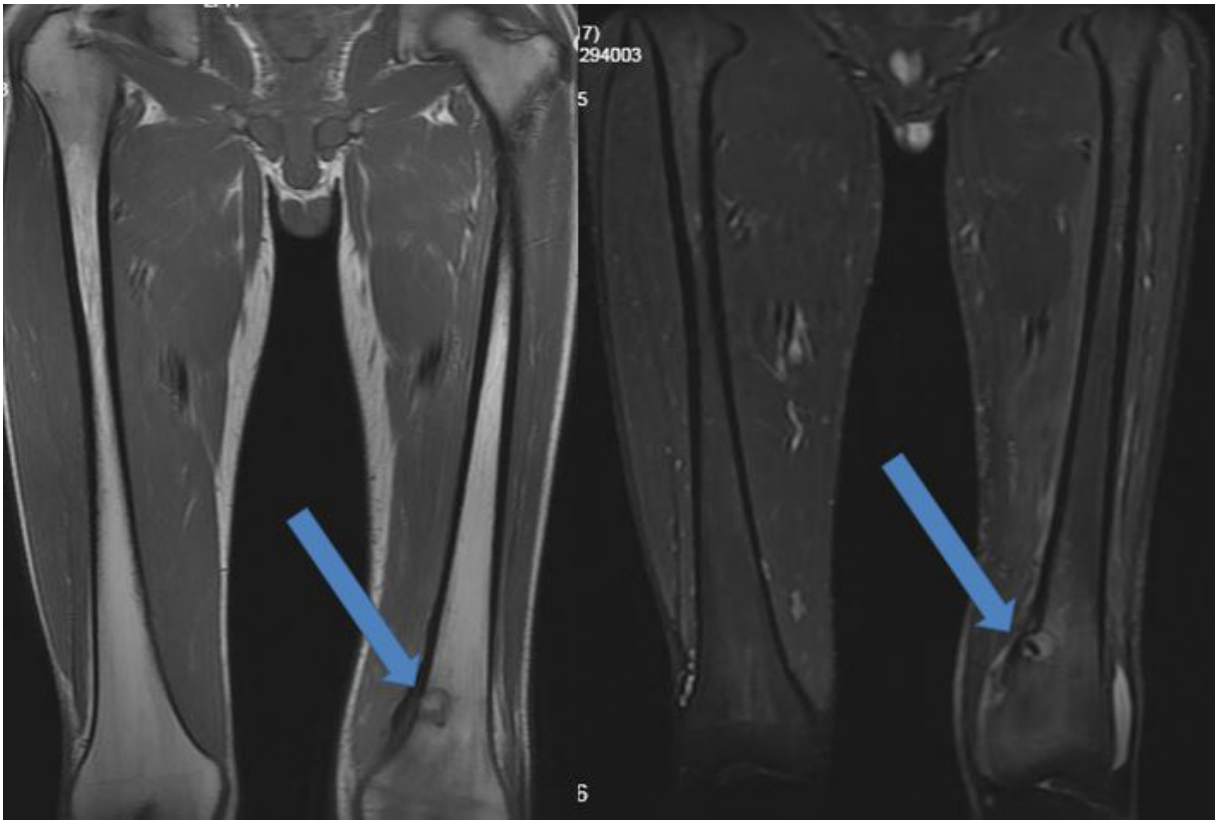

Figure 3. Osteoid osteoma distal to the left femur; typical appearance of the nidus and periosteal reaction on MRI

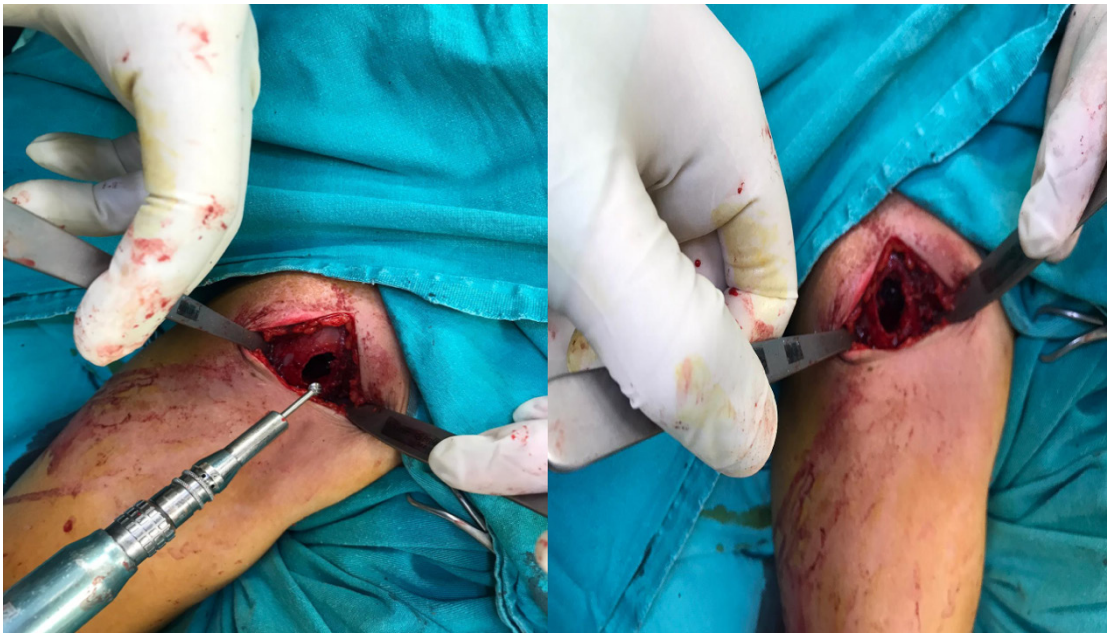

Figure 4. Burr-down-assisted intralesional curettage method in osteoid osteoma surgery

patients were followed up for one day postoperatively and then discharged. In cases where burr down is applied, even if the pathology material does not show the nidus, in patients with a preliminary diagnosis of osteoid osteoma based on preoperative clinical and radiological findings, we can clarify the diagnosis without histopathological correlation after the initial complaints resolve postoperatively. Since the nidus formation is not damaged in cases where we perform en bloc resection, osteoid osteoma can also be diagnosed with pathological evaluation. Histopathological examination of cases undergoing en bloc resection showed thickened trabeculae of bone with adjacent loose fibrovascular stroma around the dense sclerotic bone in most cases. The nidus area was seen with varying thickness and degree of demineralization. In cases where the nidus was curetted, the histopathological evaluation revealed a benign tumoral formation characterized by small young bone trabeculae among bone shavings and sclerotic bone fragments.

In the follow-up examination of the patients on the 14th day postoperatively, x-rays were taken, and the pain was questioned. For one patient with redness and increased heat in the wound site, daily dressings and antibiotic treatment were recommended to treat the superficial wound site infection. At the end of one month of follow-up, the wound site infection of the patient had completely recovered. A significant decrease in pain was observed at the end of 2 weeks in 34 patients, and within the mean two months, the pain had completely recovered in another two patients. In 2 patients, the pain had not recovered at the end of 6 months of follow-up, and as nidus was determined on follow-up CT images, a second surgery was planned. Following the second operation, a significant reduction in pain was seen in the follow-up of all patients.

DISCUSSION

Osteoid osteoma is a benign lesion originating from osteoblasts, constituting 11% of benign bone tumors and 3% of all bone tumours.[4] They are generally seen in the first three decades of life,[5] and males are seen at a rate approximately two-fold higher than females.[3] The patients in the current study comprised 20 (52.6%) males and 18 (47.4%) females, with a mean age of 12.5 years (range 3-36 years), which was consistent with data in the literature. This study investigated osteoid osteoma across all age groups because it can occur in pediatric and adult populations.

The most evident symptom of OO is pain that increases at night and is independent of activity. While pain may initially be intermittent and mild, it is severe and frequent in the advanced period. Generally, there is a response to NSAIDs and oral salicylates.[6] These characteristic findings have been determined in approximately 80% of patients.[7] In lesions determined without pain, there should be suspicion of a diagnosis of OO. In the current study, there was typical pain for OO of severity to wake the patient at night; in 25 (65.7%) cases and 29 (76.3%), there was determined to be a response to oral salicylates and NSAIDs.

Radiological imaging methods are as important as the clinical findings in diagnosing OO. Fusiform thickening in the bone cortex is the most common finding on direct radiographs, and the nidus is generally determined within this thickening. However, the nidus may not be able to be determined on plain radiographs in some cases. In this situation, CT is the most valuable method for visualizing the nidus, determining the localization, and diagnosing.[8] For this reason, almost all patients underwent computed tomography (97.4%).

Additionally, a thin-section CT is recommended for patients with an intra-cortical OO, which may be hard to diagnose due to its localization on the bone. MRI successfully shows soft tissue tumors but lags in diagnosing OO. Diagnosis errors can occur when the nidus is small and edema accompanies the lesion.[9] The study by Davies et al.[10] determined that approximately 35% of lesions could not be visualized with MRI. In the current study, MR images were available for 26 patients (68.4%).

Bone scintigraphy is a method with high sensitivity for OO. It is a helpful test when the lesion cannot be determined on direct radiographs, especially in those with atypical

symptoms.[11] The current study examined bone scintigraphy images of 19 patients (50%). Although imaging methods are crucial, a definitive diagnosis is established with the pathological visualization of the nidus. It must not be forgotten that OO can present with different localizations and an atypical clinical history. It can be confused with osteomyelitis, Brodie abscess, eosinophilic granuloma, osteoblastoma, and other benign bone masses.[12] Therefore, from the initial presentation of the patient's symptoms, each stage of diagnosis and treatment must be performed with care.

NSAIDs and oral salicylates are conservative treatment options for cases with OO. However, the need for long-term drug use and reports that some lesions have transformed into osteoblastoma in this period have pushed the conservative treatment option into the background. Surgical treatment options are wide surgical resection (en-bloc resection), burr-down-assisted intralesional curettage, and percutaneous RFA.[13,14] The success of surgical treatment depends on the complete removal of the nidus. Following removing the nidus, there is a significant reduction in the pain specific to OO. If the severity of the pain is not decreased or continues, this suggests that the nidus has not been completely removed.[15] In 2 patients in the current study, CT was performed on which the nidus was visualized as the pain did not recover during follow-up. The second surgery was planned because of incomplete surgical excision in the first operation.

Wide surgical resection (en-bloc resection) is the extensive removal of the lesion with the surrounding bone. However, this method can cause complications in intra-articular regions, which are difficult to reach. Moreover, internal fixation, bone grafting, or immobile follow-up may be required after the procedure.[16] In cases where the tumor is localized near the neuro-vascular bundle, it is surgically challenging to obtain wide resection. In the burr-down-assisted intralesional curettage method, the nidus is reached by passing through the cortex with a high-speed burr. With curettage of the nidus, it is separated for histopathological examination.[14] In both surgical methods, difficulties can be experienced in locating the nidus. In the current study, the incision region was marked on the skin from an X-ray, and CT was taken preoperatively to determine the localization of the nidus. During the operation, if the nidus could be seen on fluoroscopy, the region was marked with a Kirschner wire, reaching the nidus by passing through the cortex with the burr-down method, and curettage was then performed. In cases where the nidus could not be seen on fluoroscopy, wide surgical resection was preferred, considering the lesion localization. While the nidus is shown in the pathological diagnosis following wide surgical resection, it may not always be able to be seen in the curettage method. The point to be considered here is the patient's clinical condition and the fact that the nidus is not seen radiologically in the postoperative period.

The radiofrequency ablation method is the gold standard in treating OO.[3] RFA was first used by Rosenthal et al., [17] a technique based on the thermal necrosis principle. In a series of 263 cases, Rosenthal et al. reported a success rate of 91%. With this method, the bone integrity is not disrupted, and the patient can be discharged on the day of the procedure. However, the disadvantages of this method are that no sample can be taken for pathological diagnosis, there is radiation exposure, the risk of thermal injury, and high costs.

Limitations

The study has certain limitations. The main limitation of my research is its retrospective nature, which prevented using a scoring system to visualize patients' preoperative and postoperative pain. Additionally, despite operating on more patients, the patient population was reduced due to insufficient data in the archives. Prospective studies comparing radiofrequency ablation and surgical treatment outcomes are needed, using data from a larger number of patients.

CONCLUSION

The critical points in the diagnosis of OO are the character of the pain and the radiological visualization of the nidus. In cases where the pain wakes the patient from sleep at night and responds to NSAIDs and salicylates, OO must be kept in mind. Fine-slice CT and bone scintigraphy are used to visualize the nidus, especially if it is intracortical. The main aim of treatment must be the complete removal of the nidus, and the operation should be planned by determining the lesion localization preoperatively. The radiological disappearance of the nidus and recovery of the pain demonstrate the success of the treatment.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was approved by the Ondokuz Mayıs University Clinical Research Ethics Committee (Date: 18.05.2024, Decision No: 2022-258).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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