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A New Technique to Remove Accurately Osteoid Osteomas Using Gamma Probe

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Abstract

Study design: Description of a technique through a case-series. **Objective:** To promote a technique by using a gamma probe that asses intraoperatively the adequacy of the lesion curettage through a minimal invasive procedure. **Methods:** Reviewing the technique steps through 4 cases of osteoid osteoma surgical removal. **Results:** Four patients diagnosed with osteoid osteoma and moved to surgical removal. During the operation, excision of the tumour was assessed by a gamma probe, avoiding leaving residual lesion in the field. Operating time was not prolonged, so as the cost of the operation was not increased. **Conclusions:** Surgical excision of osteoid osteoma in spine region is still the gold standard method. Avoiding recurrence of the lesion is important. The use of gamma probe is an effective and economic solution.

Keywords

Gamma-Probe, Spine Osteoid Osteoma, Surgical Excision, Scintigraphy, Radiofrequency Ablation

1. Introduction

Osteoid osteomas (OO) are relatively rare bone tumours that 10% of cases occur in the posterior spine elements [1] [2] [3] [4]. They are characterized by a nidus of osteoid tissue less than 1.5 cm in diameter [5]. The gold standard imaging modality for the diagnosis and localisation of the lesion is a Computed Tomography (CT); whereas, a positive bone scintigraphy can assist diagnosis but does not provide the clinician with the extend of detail the cross sectional modalities do regarding the lesion location and characteristics [3].

The main symptom is pain, especially during the night; alleviated by salicylates or non-steroid anti-inflammatory drugs (NSAIDs) [6]. Patients with OO can also present with scoliotic curves especially during adolescence, which if left untreated can become structural curves [7]. Neurological impairment due to an osteoid osteoma is very rare; the main indication for surgical intervention is pain that is not controlled with medication and scoliotic curves that become structural [6] [7].

Traditionally, the surgical option is open surgery with curettage of the nidus, whereas some surgeons prefer an en bloc resection of the lesion [1] [8] [9] [10]. Percutaneous techniques with radiofrequency ablation were introduced for the treatment of OO in 1992, the main risk being the thermal injury of neural structures surrounding the lesion [11] [12] [13] [14]. On the other hand the main complication of an open surgery is the recurrence of the tumour due to incomplete excision of the nidus [15].

We describe a technique of intraoperative use of a gamma probe during minimal invasive surgical approach to assess the complete excision of the lesion and as a result to avoid recurrence due to incomplete resection.

2. Case Illustration

A 45-year-old male patient with no past medical history presented after suffering from low back pain for several months. The pain was localized at the border between the sacrum and the coccyx. The patient described the pain as constant, only partially controlled with NSAIDs and worse during the night. A Magnetic Resonance imaging that had already been performed did not offer any significant findings. The initial suspicion of an osteoid osteoma was verified by scintigraphy (**Figure 1**) and thin slice CT imaging that revealed an OO lesion of about 3 mm in diameter (**Figure 2**).

Figure 1. Bone scan depicts the lesion in sacrum.

Figure 2. CT-saggital imaging of sacral OO.

A surgical removal of the tumour was performed. The patient received radioactive traces technetium-99m (Tc-99m) 6 h prior to surgery. With the intraoperative use of a gamma probe we were able to exactly localize the tumour and confirm its complete removal.

The patient experienced immediate pain relief, he recovered uneventfully and remained completely symptom-free until the last follow up five years postoperatively.

3. Technique

A patient diagnosed with osteoid osteoma was planned for open surgery and intralesional curettage of the tumour. On the day of the surgery the patient was administered intravenously a radiopharmaceutical Tc 99m 500 MBq, the routine dose for 3 phase bone scintigraphy. 4 hours post-administration the patient was brought to the operating theatre. A ureter catheter was used to empty the bladder and routine preoperative antibiotics were administered. A posterior Wiltse approach was used with the patient being positioned prone. C-arm was used to identify the level of the lesion.

A Gamma-detecting intraoperative probe was used. This is a small, hand-held radiation-detecting device that uses auditory signals and meter read-outs of counts detected (gamma probe guidelines). Measurements are first taken from the urine (maximum counts) and from the skin away from the lesion (baseline). The probe is subsequently placed over the lesion: the area of maximum counts is marked and the counts are measured

At the level of the bone a new measurement is taken and is recorded. Curettage is performed and a new measurement is taken. This second intraoperative measurement should be lower than the preoperative measurement and close to baseline. If the measurement is still high further curettage of the area is performed until the measurement reaches the baseline. The material curetted out is also measured ex vivo and is expected to be close to the preoperative measurement of the tumour. After the measurement of the excised area drops to baseline closure can be performed. Through the application of gamma probe we avoid extending the incision and dissections more than it is needed. Thus, this minimal invasive procedure has less complications and much less postoperative pain.

Three more cases were performed in which osteoid osteomas were excised from the junction of the left transverse process with the lamina in L2 (**Figure 3**), the left transverse process of L3 (**Figure 4**) and the lamina of L3 vertebra. Typical

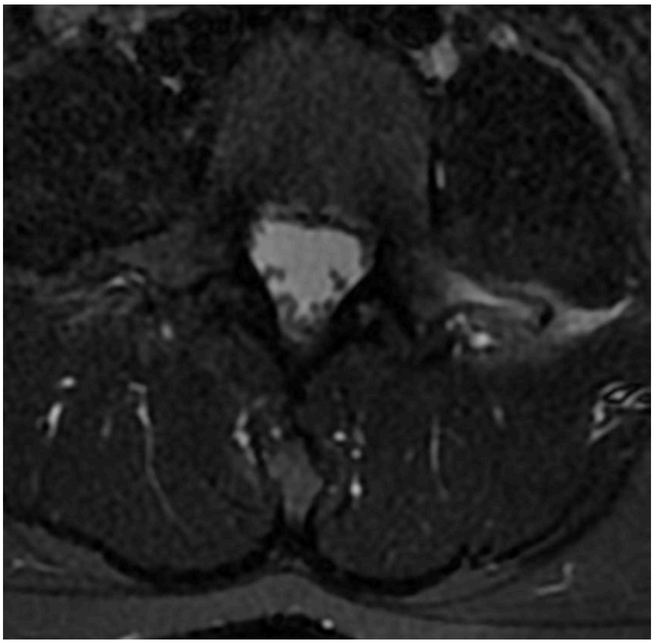

Figure 3. MRI of L2 vertebra with OO in junction of TP and lamina.

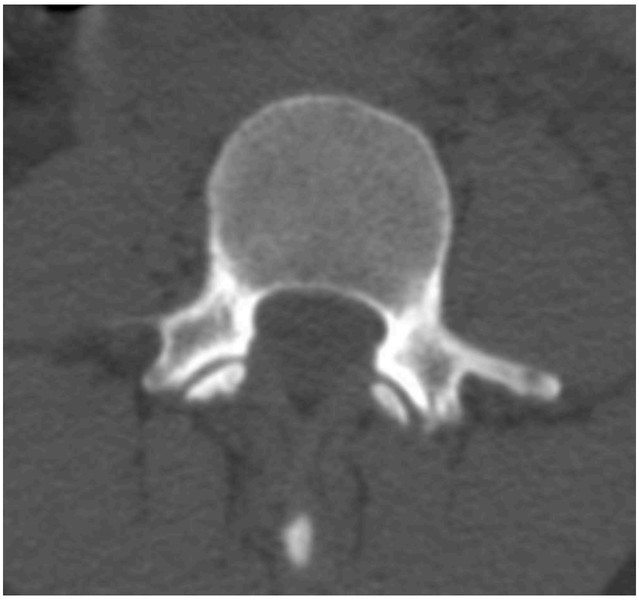

Figure 4. CT of L3 vertebra depicts OO in transverse process.

posterior paraspinal approach was used. The procedure followed the same steps as in the illustrated case. In a two-year follow-up, no recurrence was identified.

4. Discussion

The goal of treatment of an osteoid osteoma is a complete resection of the nidus. The gold standard of treatment is still an open surgery for tumours located in the spine [15]. Minimally invasive methods and radiofrequency ablation are widely used for tumours of the appendicular skeleton, but authors are sceptical about their safety for lesions in the spine. There are studies suggesting that if neural structures are within 13 mm of the probe they can be permanently injured [16] [17]. An additional disadvantage of minimally invasive techniques is the uncertainty around the histological verification of specimens.

Another approach to treatment of these tumours is the en bloc resection [16]. This option is more aggressive and depending on the exact location of the tumour in the spine need for instrumentation can arise, increasing morbidity and the risk for surgical complications, including the participation of other specialists like general surgeons, plastic surgeons or vascular surgeons, which affect the cost, the time and the complexity of the procedure. Studies have found no recurrence in patients treated with en bloc resection, but authors are not recommending this method for every case, acknowledging the potential high morbidity risks of the more complex surgery that results [15]. They conclude that the complete excision of the nidus is more important than the surgical margins. Other research on a large series of intralesional excision of osteoid osteomas identified a recurrence rate of 6%, a percentage that despite relatively low, suggests that most of these patients requiring further surgical intervention [1]. It has been shown that the main reason for recurrence is the incomplete excision of the nidus with the intralesional curettage of the tumour [15].

The method we recommend implementing an intraoperative gamma-detecting probe is a simple, inexpensive method. It is safe for the patient and does not add substantive operating time. With this method we can confirm intraoperatively the complete excision of the nidus, decreasing the risk of recurrence. It can be used in any surgical site and can provide information for every location of the tumour.

The probe can also be used to plan the skin incision. Lesions that are difficult to identify with fluoroscopy can be marked with the probe finding the point on the skin with the maximum counts, which can be used for the skin incision and to plan the approach. By using this method, we managed to keep the exposure minimal in the case of the sacral osteoid osteoma described above.

We used this method in 4 cases of osteoid osteoma; three in the spine and one in the calcaneus. Follow up is 3 years with minimum of 1 year. There has been no recurrence of the symptoms for our patients. The number of patients is very small to assess the reliability of the method and further studies are needed with greater sample size. In all our cases we managed to locate the tumour with the gamma probe, performed open curettage of the tumour and in every case the measurements dropped significantly approaching the preoperative baseline ones. In 2 out of 4 cases the measurements were not close to the baseline, therefore we continued curetting until they dropped to the baseline. In those cases we believe that the use of the gamma-probe helped us avoid the incomplete resection of the tumour, and therefore the likely reoccurrence.

5. Conclusion

The use of Gamma-detecting probe intraoperatively to assess the complete resection of the nidus during intralesion excision of an osteoid osteoma is a feasible method that is simple to perform, has the advantage of low cost as the gamma probe is available in every operation theatre and the cost of its use is much less, comparatively to that of installing a navigation device, is safe for the patient and does not prolong the operating time. There was no need for contribution of other specialists like general surgeons or plastic surgeons, as the procedure was minimal invasive and no extended incisions and dissections were needed intraoperatively, which could lead to prolonged hospitalization or complications from surgical wound, that may affect the cost for the patient and the health system. The most important advantage that we identified is the fact that it can decrease the recurrence rate due to incomplete excision of the nidus that can be avoided by intraoperative measurement-guided excision. All cases were approached by this minimal invasive technique from one surgical team and no open excision was performed. In future we may need to compare this series with other that is referred to open excision in order to compare these techniques.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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