Significant Soft Tissue Swelling and Pain after Radiofrequency Ablation of Proximal Phalanx Osteoid Osteoma with Resolution of Symptoms after Surgical Excision, A Case Report

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ABSTRACT

Bony tumors in the hand and wrist are relatively rare conditions with most being enchondromas with osteoid osteomas being found less frequently. Management of these lesions ranges from medical treatment with nonsteroidal anti-inflammatory drugs (NSAIDS) to procedures including radiofrequency ablation (RF) or excision of the lesion. RF has been used for osteoid osteoma lesions throughout the skeleton but the literature is sparse and guarded regarding its use in the hand and carpus due to concern for damage to adjacent soft tissues and neurovascular structures. The objective of this article is to describe an impressive soft tissue reaction after RF was utilized to treat a proximal phalangeal osteoid osteoma in the hand. We feel RF should be cautiously used in the treatment of these lesions due to concern for similar complications.

KEY WORDS

osteoid osteoma, radiofrequency ablation, phalangeal tumors

With the exception of enchondromas, bony tumors in the hand and wrist are relatively uncommon. Osteoid osteomas account for approximately 10-15% of all benign bony tumors and approximately 5-15% of osteoid osteomas occur in the hand and wrist with most located in the proximal phalanx and carpus.[1-3] Treatment can involve medical management with NSAIDS, open surgery with excision of the nidus, or image guided treatment methods such as percutaneous radiofrequency ablation (RF) where typically the lesion is precisely identified via Computed Tomography (CT)-guidance and a radiofrequency electrode at 90 degrees centigrade ablates the lesion for 4-6 minutes.[4-9] NSAIDS can take months to years to resolve pain; whereas, RF and surgery can typically resolve pain more expeditiously after ablation/excision.[10-11] Complications can result from each treatment modality, and RF has been widely reported as a successful treatment option for osteoid osteoma. However, RF in hand and wrist lesions has remained controversial due to close proximity of the neurovascular structures and soft tissues.[12] Hence, RF treatment in phalangeal osteoid osteomas has been rarely reported without complications noted.[13-15]

We report a clinical case in which a proximal phalangeal osteoid osteoma was identified in a young man and was treated via inadequate surgical excision then subsequent RF with intensification of pain and increased soft tissue swelling. Revision surgery was undertaken with excision of the osteoid osteoma nidus with resolution of pain. The severity of pain and the soft tissue reaction after RF was impressive and we feel should be reported as a complication due to RF.

The patient was informed that data concerning this case would be submitted for publication.

CASE REPORT

A healthy thirty- seven year old right hand dominant gentleman who works as an auto technician initially noted localized pain and swelling at the base of his right middle finger in October 2005. The pain was insidious in onset and progressive in nature and bothered him mostly at night. There was no obvious trauma or focal injury that the patient could remember but he thought it was likely due to some minor trauma that might have occurred during his routine work. However, as it persisted, he sought aid from his primary care physician. The primary care physician had him evaluated by a hand specialist. His history was reviewed and on physical exam was noted to have a swollen right long finger proximal phalanx with no skin changes or atrophy but he was tender at this region predominately volarly and ulnarly. Range of motion showed full extension at his metacarpophalangeal and proximal and distal interphalangeal joints with full strength throughout his hand, but flexion was mildly limited due to the soft tissue swelling actively near the metacarpophalangeal joint with no difference in active and passive ROM. His sensibility throughout his radial, median and ulnar nerve distributions was intact to light touch, prick, and static and dynamic two point discrimination was 5-10 mm. No motor deficits were noted. He had no evidence of ischemia in his finger tip with capillary refill <2 seconds. To aid in his diagnosis, he pursued radiographic imaging to aid in evaluation of the soft tissue swelling. Radiographs were obtained which showed a cortical thickening of the proximal phalanx with noted overlying soft tissue swelling. To better define the lesion, a magnetic resonance imaging scan (MRI) of the hand

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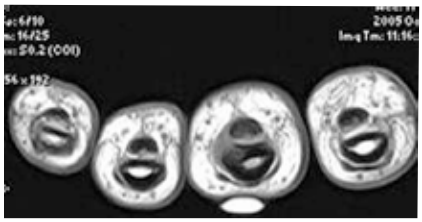
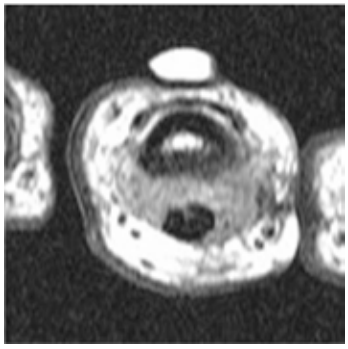


A

B

Figure 1: Preoperative T1-weighted Axial (A) and Sagital (B) images of preoperative magnetic resonance imaging without contrast demonstrate a cortical lesion (arrow) in the volar, ulnar aspect of the right middle finger with central nidus and surrounding lytic areas. Soft tissue and bone marrow edema are noted.



A B

Figure 2: Postoperative T1-weighted Coronal (A) and Axial (B) images of preoperative magnetic resonance imaging without contrast demonstrate residual cortical lesion (arrow) in the volar, ulnar aspect of the right middle finger with visible nidus.

was obtained which showed asymmetric cortical thickening along the volar ulnar aspect of the right middle finger proximal phalanx as seen in **figure 1** without fracture. The patient was diagnosed with a right middle finger proximal phalangeal osteoid osteoma based on the clinical and radiographic results and was initially treated with observation and NSAIDS.

The pain in his finger improved minimally despite sporadic NSAID treatment by the patient for 3 months. Due to the persistent symptoms, he was reevaluated and given the option of continued medical treatment versus operative intervention with excision of the nidus. Via an ulnar mid-axial incision under fluoroscopy the right middle finger proximal phalangeal lesion was excised. The bone was deemed stable and no internal or external fixation was placed. Pathology could not confirm a nidus or definite diagnosis of osteoid osteoma.

Following the procedure, the patient underwent routine hand occupational therapy and retained good range of motion, strength, and sensibility. However, his pain persisted despite continued use of NSAIDS. Seven months postoperatively, repeat MRI was ordered and confirmed residual nidus as seen in **figure 2**. Symptoms persisted over the next twelve months and after discussion with the patient regarding re-excision versus other intervention, the patient was referred to an interventional

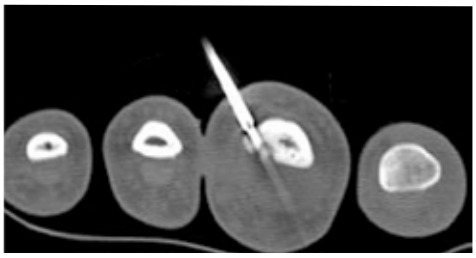


Figure 3: Intraoperative axial computed tomography images demonstrating radiofrequency ablation probe tip in center of lesion.

radiologist for evaluation of RF. CT scan without contrast for preablation planning prior to RF noted the sclerotic nidus with adjacent bone spur at the ulnar side of the proximal phalanx in addition to soft tissue swelling overlying this region.

RF was performed after standard preparation and local anesthesia with 1% lidocaine. Under CT guidance, a RITA XL probe was advanced into the nidus and a three minute ablation was performed at 90 Celsius with approximately 0.5 cm of the probe exposed into the osteoid osteoma nidus (**Figure 3**). Of note, ice packs and cooling towels were used in an attempt to protect skin and soft tissues from thermal damage. No immediate complications were reported and the procedure was deemed successful.

Follow up appointments at weekly intervals for the first month then follow up at 2 months demonstrated initial decrease in night pain but recurrence of pain at 2 weeks post-ablation. Motrin 400mg each night did help decrease symptoms but swelling and pain persisted. At 3 months follow up, the pain was noticeably worse during both day and night. He was given referral to an interventional radiologist at our institution with extensive experience treating osteoid osteomas with RF. At this point, the patient was referred to the senior author (JBJ) for evaluation due to reluctance to treat phalangeal lesions with RF.

Upon our evaluation, his symptoms and history were reviewed. Physical examination was notable for swelling/nodule about the ulnar aspect of the proximal phalanx, good ROM and sensibility and vascularity were intact. Weakness in grip (36 versus 60 pounds) and pinch (22 versus 28 pounds) were noted in comparison to the left side. Radiographic images confirmed a persistent sclerotic bony lesion. The decision was made to re-excise the nidus to effect pain relief. The patient was taken to the operating room 27 months after the index surgery and nine months after RF. After standard prep and application of tourniquet, prior mid-axial incision was utilized along the ulnar aspect of the proximal phalanx. The neurovascular bundle was identified and protected but a large amount of reactive tissue was noted, and we found crossing sensory branches of the ulnar digital nerve entwined within the tissue. After dissection was carried to the surface of the bone, the lesion was clearly visible and most accessible volarly. The flexor tendons were notable for great deal of tenosynovitis which was debrided and sent as specimen with additional cultures retrieved. Using fluoroscopy, the nidus was isolated and bone resection was planned. A large segment of the sclerotic mass was removed and confirmed with fluoroscopic imaging. Both proximal and

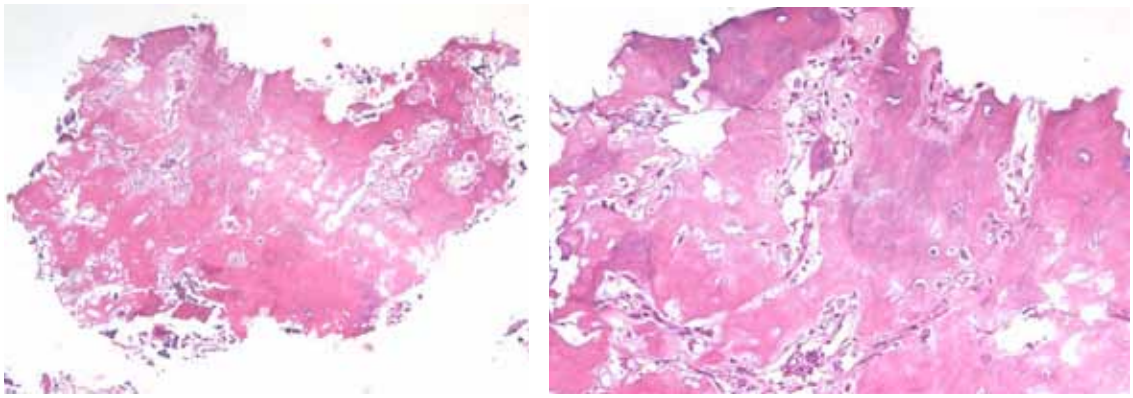


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Figure 4: Hematoyxlin and Eosin stained low (A) and high (B) powered slides from right middle finger proximal phalangeal mass demonstrating central nidus of osteoblasts (large arrow) and osteoid with surrounding osteoclasts (small arrow) typically visualized in osteoid osteoma.

A B C D

Figure 5: Postoperative photographs of the right hand and middle finger demonstrating postoperative range of motion including extension, abduction, and flexion views (A, B) in addition to lateral and volar views of the closed fist (C, D).

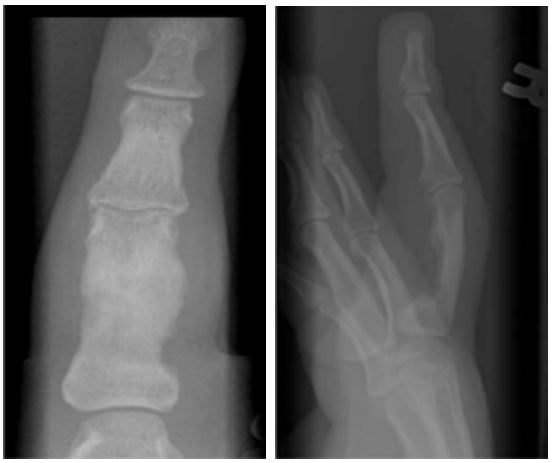

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Figure 6: Postoperative posteroanterior (A) and lateral (B) radiograghs demonstrate no evidence of residual nidus or postoperative fracture. Some postoperative adjacent heterotopic ossification is noted alongside remodeling of the mid-diaphysis of the right middle finger proximal phalanx.

distal margins were left in vivo. The remaining bone seemed stable both fluoroscopically and under direct vision; therefore, no grafting and additional fixation was used. Wound was irrigated and closed without difficulty.

Postoperative pathology reports confirmed the diagnosis of osteoid osteoma with visualization of the nidus as seen in **Figure 4.** Postoperatively, the patient's pain has completely resolved and the wound is well healed. The neurovascular exam is intact and swelling is progressively decreasing. Range of motion was initially decreased acutely (**Figure 5**) but returned to full after rigid therapy protocol and postoperative radiographs confirm no evidence of residual nidus or fracture (**Figure 6**).

DISCUSSION

Though osteoid osteomas can account for 10-15% of all benign bony tumors, the upper extremity is much less frequently involved than typical locations such as lower extremity long bones.[1] Treatment has been deemed successful with both medical and surgical or procedural interventions. Kneisl et al demonstrated that similar results of pain relief can be achieved with either surgical excision or treatment with nonsteroidal anti-inflammatory drugs (NSAIDS) though average time to pain relief was reported as 33 months.[11] Although classic surgical treatment involves either curettage or en bloc resection of the lesion, multiple other image guided procedures and techniques including drilling, trephination, ethanol and laser therapy, and cryotherapy have evolved but image guided-radiofrequency ablation is most widely accepted.[17] Rozenthal and others contend that CT guided-RF is a less invasive and more precise alternative with potentially less bone destruction, shorter hospitalization time, quicker rehabilitation time, and equal safety and efficacy. [12, 16, 18]

Treatment of osteoid osteomas in the hand has proved more challenging than in other areas. Surgical treatment of osteoid osteomas in the hand has been widely reported in the literature with the largest series showing 74% success in 19 lesions of the hand and carpus (5 recurrences requiring 12 total procedures) compared with 96% in the remainder of the upper extremity.[19-20] Proposed aids in successful excision

included intraoperative radionuclide localization and preoperative CT-guided needle localization to remedy inadequate bony resection. In our patient, inadequate resection was the initial cause of his failure as he had both lack of pain relief and radiographic evidence of residual nidus.

RF affords good visualization via imaging and RF has reported success rates of 89-100% throughout the skeleton.[11,17,18] However, treatment of osteoid osteoma in the hand and spine have been controversial due to concern over close relationship to neurovascular structures and uncertainty over thermal injury though reports of RF to spinal lesions is more common.[1,21-24] Based on canine studies, investigators at our institution have recommended maintenance of a 1cm distance from important structures due to thermal necrosis while some recommend 1.5cm.[17,25] Soong et al have reported good results with RF treatment in upper extremity lesions but did not include lesions in the hand due to above concern.[26] Nineteen of twenty-five lesions were deemed successfully treated based on patient completed questionnaires related to their pain relief, need for other intervention, and complications). Four partial failures and two failures were noted. One partial failure was noted due to decreased RF temperature (80°C instead of 90°C) because of the proximity of a neurovascular bundle. The two failures included a patient who had received decreased RF duration (1 minute instead of 6 minutes) due to proximity of a neurovascular bundle the second patient had 2 failed surgical procedures before RF. Both were successfully treated by surgical excision.

To the best of our knowledge, this is the first case study to be reported in documenting a complication of RF of an osteoid osteoma in the hand. One interesting component of our case is the symptomatology. After RF, the patient reported significant increase in both the intensity and frequency of the pain in addition to increased focal swelling. Given his post-RF symptoms, impressive soft tissue reaction, and final postoperative pathological confirmation of the nidus with resultant postoperative pain relief, we feel that this qualifies as a complication of RF. Unfortunately the most impressive finding was the extent of local soft tissue damage with entwined nerves. There have been three other documented reports of RF treatment of hand osteoid osteomas in the literature but no complications have been reported. Vanderschueren's study of 97 skeletal lesions included 8 lesions of the hand and carpus but no procedural considerations, outcomes, or complications specific to those locations were reported other than the fact that 3 ("hand patients") of these patients went on to have residual or recurrent symptoms without report of final resolution of pain or definitive additional treatment.[13] Zouari et al report on 15 lesions (only ten of which were histologically confirmed osteoid osteoma) with eight located in the hand and carpus with no adverse events related to the procedure or to the location of the tumor recorded.[14] The only other reported study was a case report in which a 26-year-old man with an osteoid osteoma in the proximal phalanx of the right middle finger was treated with percutaneous radiofrequency ablation. Per report, he remained pain-free with normal finger function at 2 year follow-up. Interestingly they noted the neurovascular bundle to be 6mm and the flexor tendon sheath to be 5mm from the tip of the probe.[15]

Of note, Cantwell et al do reported new techniques that employ cooled radiofrequency probes and impedance control energy delivery from a 200-W generator in 11 patients with osteoid osteoma with no complications and full resolution of pain within one week though no lesions were in the hand.[27] Cantwell et al also reported MRI evaluation of the above technique to determine zone of bone marrow changes in 10 patients at 1, 7, and 28 days. The width was 20.9 and 30.5mm with 1 cm and 2 cm tip probes, respectively. The conclusion was that higher-output generators with impedance-control software and internally cooled radiofrequency probes with longer exposed tips produce larger zones of marrow signal change than expected with manual-control protocols.[28] These findings seem to support the early canine studies done by Tillotson et al with a 1cm zone of necrosis extending from the RF tip.[25] Destruction of soft tissues in this area has given significant concern over performing RF in the hand.

The desire to use minimally invasive and emerging technologies throughout medicine is strong. In our case, RF might not be best utilized in regions of the hand given the intricate relationships of the soft tissues and neurovascular structures. There may also have been an additional thermal damage to the surrounding soft tissues and ulnar digital nerve which could explain the hyperintense post-RF pain. We feel that further investigation needs to be performed regarding the use of RF in the hand and carpus as intimate relationships of the neurovascular structures and soft tissues increase the risk of their damage. RF in the hand osteoid osteomas may not be a completely benign treatment modality.

References

1. **Dahlin DC, Unni KK:** Bone tumors: general aspects and data on 8542 cases, 4th ed. Springfield: Thomas, 1986:88-101.
2. **Canale & Beaty:** Campbell's Operative Orthopaedics, 11th ed. Philadelphia: Moseby, an imprint of Elsevier, 2007. 855-857.
3. **Green, DP:** Green's Benign Bone Tumors In: Green's Operative Hand Surgery. 5th ed. Philadelphia: Elsevier Churchill Livingstone 2005. 2248-2256
4 **Ciabattoni G, Tamburrelli F, Greco F.:** Increased prostacyclin biosynthesis in patients with osteoid osteoma. Eicosanoids. 1991;4(3):165-7
5. **Hasegawa T, Hirose T, Sakamoto R, et al:** Mechanism of pain in osteoid osteomas: an immunohisto-chemical study. Histopathology 1993; 22:487–491.
6. **O'Connell JX, Nanthakumar SS, Nielsen GP, et al:** Osteoid osteoma: the uniquely innervated bone tumor. Mod Pathol 1998; 11:175–180.
7. **Greco F, Tamburrelli F, Laudati A, et al:** Nerve fibres in osteoid osteoma. Ital J Orthop Traumatol 1988; 14:91–94.
8. **Rosenthal DI, Alexander A, Rosenberg AE, Springfield D.:** Ablation of osteoid osteomas with a percutaneously placed electrode: a new procedure. Radiology. 1992 Apr;183(1):29-33.
9. **Campanacci M, Ruggieri P, Gasbarrini A, Ferraro A, Campanacci L.:** Osteoid osteoma: direct visual identification and intralesional excision of the nidus with minimal removal of bone. J Bone Joint Surg Br 1999; 81:814–820.
10. **Bottner F, Roedl R, Wortler K, Grethen C, Winkelmann W, Lindner N:** Cyclooxygenase-2 inhibitor for pain management in osteoid osteoma. Clin Orthop Relat Res. 2001 Dec;(393):258-63.
11. **Lindner NJ, Ozaki T, Roedl R, Gosheger G, Winkelmann W, Wörtler K.:** Percutaneous radiofrequency ablation in osteoid osteoma. J Bone Joint Surg Br. 2001 Apr;83(3):391-6.
12. **Rosenthal DI, Hornicek FJ, Wolfe MW, Jennings LC, Gebhardt MC, Mankin HJ:** Percutaneous radiofrequency coagulation of osteoid osteoma compared with operative treatment. J Bone Joint Surg Am. 1998 Jun;80(6):815-21.
13. **Vanderschueren GM, Taminiau AHM, Obermann WR, Bloem JL:** Osteoid Osteoma: Clinical Results with Thermocoagulation. Radiology 2002; 224:82–86.
14. **Zouari L, Bousson V, Hamzé B, Roulot E, Roqueplan F, Laredo JD.** CT-guided percutaneous laser photocoagulation of osteoid osteomas of the hands and feet. Eur Radiol. 2008 Nov;18(11):2635-41.
15. **Ramos L, Santos JA, Santos G, Guiral J.:** Radiofrequency ablation in osteoid osteoma of the finger. J Hand Surg [Am]. 2005 Jul;30(4):798-802.
16. **Kneisl JS. Simon MA:** Medical management compared with operative treatment for osteoid-osteoma. Journal of Bone & Joint Surgery - American Volume. 74(2):179-85, 1992 Feb. UI: 1541612
17. **Cantwell CP, Obyrne J, Eustace S.:** Current trends in treatment of osteoid osteoma with an emphasis on radiofrequency ablation. Eur Radiol 2004;14:607– 617.
18. **Rosenthal DI, Hornicek FJ, Torriani M, Gebhardt MC, Mankin HJ:** Osteoid osteoma: percutaneous treatment with radiofrequency energy. Radiology 2003;229:171–175.
19. **Bednar MS, Weiland AJ, Light TR:** Osteoid osteoma of the upper extremity. Hand Clin 1995;11:211–221.
20. **Ambrosia JM, Wold LE, Amadio PC:** Osteoid osteoma of the hand and wrist. J Hand Surg 1987;12A:794–800.
21. **Cové JA, Taminiau AH, Obermann WR, Vanderschueren GM:** Osteoid osteoma of the spine treated with percutaneous computed tomography-guided thermocoagulation. Spine 2000;25:1283–1286.
22. **Dupuy DE, Hong R, Oliver B, Goldberg SN:** Radiofrequency ablation of spinal tumors: temperature distribution in the spinal canal. AJR Am J Roentgenol 2000;175:1263–1266.
23. **Osti OL, Sebben R:** High-frequency radio-wave ablation of osteoid osteoma in the lumbar spine. Eur Spine J 1998;7: 422–425.
24. **De Berg JC, Pattynama PMT, Obermann WR, Bode PJ, Vielvoye GJ, Taminiau AHM:** Percutaneous computed-tomography- guided thermocoagulation. Lancet. 1995 Aug 5; 346(8971):350-1.
25. **C.L. Tillotson, A.E. Rosenberg and D.I. Rosenthal:** Controlled thermal injury of bone. Report of a percutaneous technique using radiofrequency electrode and generator, Invest Radiol 24 (1989), pp. 888–892.
26. **Soong M. Jupiter J. Rosenthal D:** Radiofrequency ablation of osteoid osteoma in the upper extremity. Journal of Hand Surgery - American Volume. 31(2):279-83, 2006 Feb.
27. **Cantwell CP. O'Byrne J. Eustace S:** Radiofrequency ablation of osteoid osteoma with cooled probes and impedance-control energy delivery. American Journal of Roentgenology. 186(5 Suppl):S244-8, 2006 May.
28. **Cantwell CP. Kerr J. O'Byrne J. Eustace S:** MRI features after radiofrequency ablation of osteoid osteoma with cooled probes and impedance-control energy delivery. AJR. American Journal of Roentgenology. 186(5):1220-7, 2006 May.