Rare coexistence of multiple osteochondromas and solitary osteoid osteoma: A case report

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Abstract. Multiple osteochondromas (MOs) are inherited in an autosomal-dominant manner, with a penetrance of ~96 and 100% in female and male patients, respectively. Osteochondromas primarily involve the metaphyses and diaphyses of long bones, including the ribs. Osteoid osteomas account for ~3 and 11% of all bone tumors and benign bone tumors, respectively. Furthermore,1 the male-to-female ratio is 2-3:1, and they generally occur in the long bones of the lower extremities, with the femoral neck being the most frequent site. The present study describes the case of a 16-year-old male patient with a bony mass around the left knee joint and pain in the left calf. Radiography revealed MOs in the upper and lower extremities, while computed tomography showed a nidus in the cortex of the tibial shaft. The patient's family history included the presence of MOs, and the patient was diagnosed with MOs and a solitary osteoid osteoma. Surgical excision of the osteochondroma and curettage of the osteoid osteoma in the proximal tibia and tibial shaft, respectively, were performed simultaneously. Postoperative pathological examination revealed osteochondroma and osteoid osteoma. Furthermore, the pain resolved, and no recurrence was observed 7 months post-operation. To the best of our knowledge, no reports exist on coexisting MOs and osteoid osteoma; therefore, the present study describes the first case of such a condition. Marginal excision for osteochondroma and curettage for osteoid osteoma effectively improved the symptoms.

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Abbreviations: MO, multiple osteochondroma; NSAIDs, non-steroidal anti-inflammatory drugs; VAS, visual analog scale; STIR, short-tau inversion recovery; CT, computed tomography; EXT1, exotosin-1; EXT2, exotosin-2

Key words: hereditary multiple exostoses, multiple osteochondromas, osteoid osteoma, coexistence, case report

Introduction

Multiple osteochondroma (MO), previously known as hereditary multiple exostoses, was first described by Boyer in 1814 (1). It occurs as benign multiple cartilaginous bone tumors in early childhood and ossifies when skeletal growth is complete. MO occurs at a rate of 1 in 50,000 in Western populations, exhibiting a male-to-female ratio of 1.5 (2). It is also inherited in an autosomal-dominant manner, with a penetrance of approximately 96 and 100% in females and males, respectively (3). Osteochondromas primarily involve the metaphyses and diaphyses of long bones, including the ribs (4), and are associated with reduced skeletal growth, bone deformities, limited joint range of motion, short stature, premature osteoarthritis, and peripheral nerve compression (5). Surgeries for osteochondromas are based on the symptoms, such as pain, swelling, or reduced range of motion (6). Heterozygous defects in the exostosin-1 (*EXT1*) and exostosin-2 (*EXT2*) genes have been suggested to induce MO (7,8), and the lifetime risk of malignant transformation in MO is estimated at 4% (9). Another study suggested that patients with *EXT1* mutations statistically have a 1.5 times higher risk of malignant transformation than those with unstratified gene or *EXT2* mutations (10).

Osteoid osteomas account for approximately 3 and 11% of all bone tumors and benign ones, respectively (11), with a male-to-female ratio of approximately 2-3:1. They can occur in any bone of the body. Osteoid osteomas frequently occur in males aged between 10 and 30 years and affect long bones, such as the femur and tibia (11,12). They generally occur in the long bones of the lower extremities, with the femoral neck as the most frequent site (13). Osteoid osteoma has a sclerotic bony lesion with a diameter of 2 cm known as the nidus and is considered to induce pain (14). The lesion exhibited a high level of prostaglandin E2 that caused severe pain; it was usually treated with nonsteroidal anti-inflammatory drugs (NSAIDs) (15), which are typically effective nonsurgical treatments for pain in osteoid osteomas (15). However, many patients cannot continue taking NSAIDs in the long term; therefore, they usually require surgery. Recently, Fittall *et al* reported that recurrent rearrangements of *FOS* or *FOSB* were found in osteoblastomas and osteoid osteomas (16). However, to our knowledge, no association has been reported between *EXT1*/*EXT2* and *FOS*/*FOSB*.

Although MO and osteoid osteoma are rare, their coexistence has never been reported. Therefore, we describe a case of coexisting MO and osteoid osteoma that was treated with marginal excision and curettage at our institution.

Case report

A 16-year-old male patient with a 3-month history of left calf pain and a bony mass on the left knee from the previous hospital was referred to the Department of Orthopedic Surgery, University of the Ryukyus in December 2019. The patient had a family history of MO, for which the mother and maternal grandmother underwent surgery. The patient was 158 cm tall, weighed 46 kg, and had no relevant medical history. Although the patient did not report night pain, physical examination showed multiple bony prominences around both knee joints and tenderness on the medial side of the left lower leg on a 60 mm pain visual analog scale (VAS). Laboratory data showed that inflammatory reactions and serum alkaline phosphatase levels were not elevated. Radiography revealed MOs on the left proximal humerus, right distal ulna, right distal femur, proximal tibiae, and fibulas (Fig. 1A-D). Additionally, the epiphyseal line was almost closed. Computed tomography (CT) revealed a fungiform osteochondroma on the medial side of the proximal tibia and the nidus of the medial shaft of the tibia (Fig. 2A and B). Magnetic resonance imaging revealed a high-intensity layer of the cartilaginous cap on the fungiform osteochondroma of the proximal tibia on short-tau inversion recovery (STIR) images (Fig. 3A). The nidus surrounding the bone edema was also confirmed in the left tibial shaft on the STIR image (Fig. 3B). A ^{99m}Tc bone scintigraphy showed strong accumulation in the medial tibial shaft. Based on the family history and imaging findings, the patient was diagnosed with MO and solitary osteoid osteoma of the left tibial shaft.

The patient underwent surgery to relieve the pain, and marginal excision of the osteochondroma of the left proximal tibia was performed. Cone-beam CT-guided curettage was also performed during the same surgery for osteoid osteoma of the tibial shaft. Notably, the pain in the left calf resolved, and the pain VAS score was 0 mm immediately after surgery. Pathological examinations revealed an osteoid formation surrounded by osteoblasts in the osteoid osteoma lesion and a hyaline cartilage cap in the osteochondroma lesion (Fig. 4A and B). However, no bony prominence or pain recurrence occurred at the final follow-up 7 months postoperatively, and the patient could skateboard.

Discussion

We report, for the first time, to our knowledge, a case of coexisting osteochondroma and osteoid osteoma, which were located in the proximal tibia and tibial shaft. Although genetic examinations, such as *EXT1*/*EXT2* and *FOS*/*FOSB* (7,8,16), were not performed in this case, pathological examination confirmed the proximal tibia and tibial shaft lesions as osteochondroma and osteoid osteoma, respectively. Therefore, further investigation on the genetic status of this case may be warranted to help understand the genetic/pathologic mechanisms of coexisting MO and osteoid osteoma.

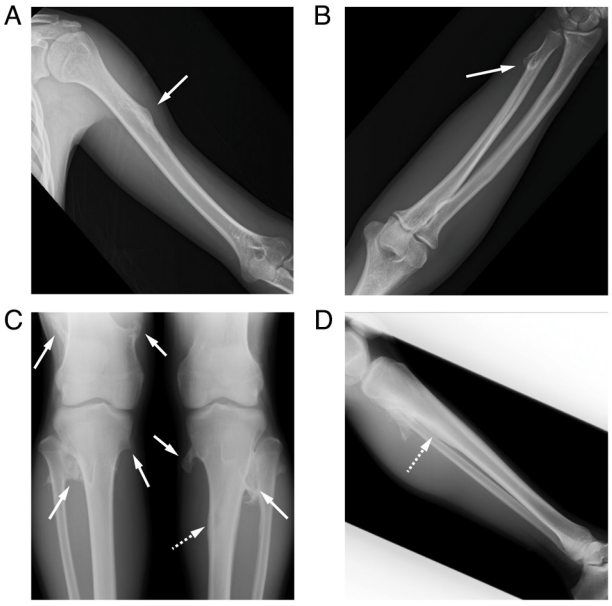

Figure 1. Preoperative radiographs. (A) Osteochondromas on the left proximal humerus, (B) the right distal ulna, (C) distal femurs, and proximal tibiae and fibulas can be observed (white arrows). (C and D) The thickened sclerotic bone surrounding the central core of radiolucent density can be observed in the left tibial shaft (dotted arrows).

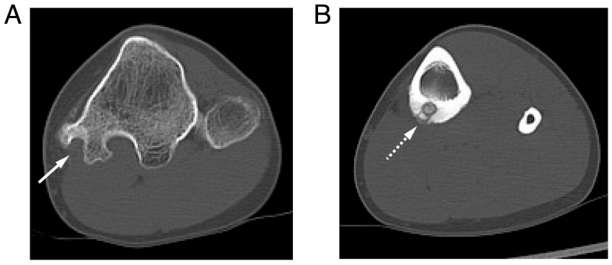

Figure 2. Preoperative computed tomography. (A) A fungiform osteochondroma in the medial side of the proximal tibia can be observed (arrow). (B) A nidus of the medial shaft of the tibia can be observed (dotted arrow).

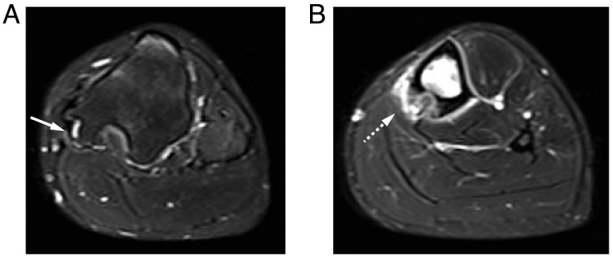

Figure 3. Preoperative magnetic resonance imaging. (A) A high-intensity layer of cartilaginous cap (arrow) on the fungiform osteochondroma of the proximal tibia on STIR image. (B) The nidus surrounding bone edema (dotted arrow) was confirmed in the left tibial shaft on the STIR image. STIR, short-tau inversion recovery.

Multiple osteoid osteomas are very rare. To our knowledge, a total of 37 cases of multiple osteoid osteomas have been reported in the literature (17-20). Aynaci *et al* reported 24 cases of multiple osteoid osteomas in the same bone, which included one case they reported (19). Six cases of multiple osteoid osteomas in adjacent bones have been reported (19,21),

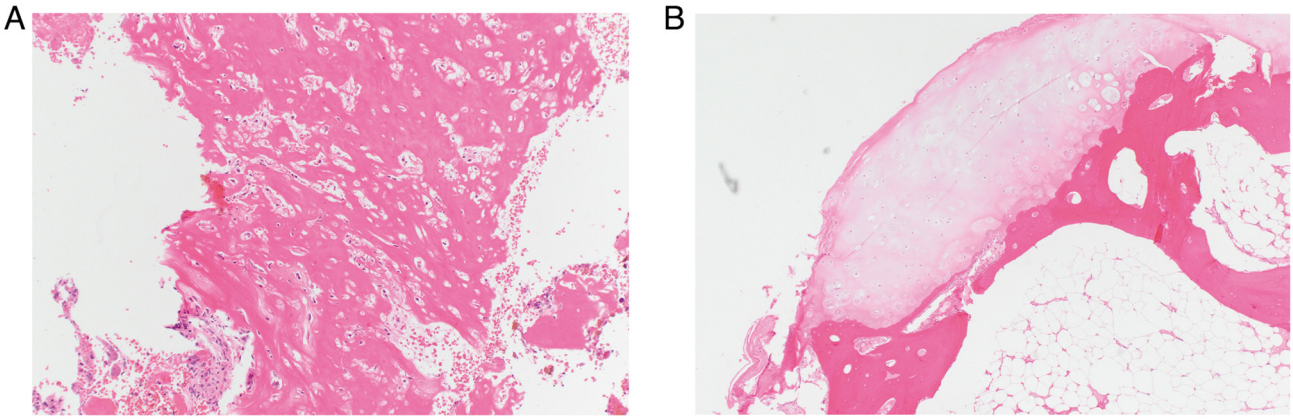

Figure 4. Postoperative pathological findings. (A) H&E staining reveals osteoid formation surrounded with osteoblasts in the osteoid osteoma lesion, x100 magnification. (B) H&E staining shows a hyaline cartilage cap in the osteochondroma lesion, x40 magnification. H&E, hematoxylin and eosin.

starting with Larsen *et al* (21), whereas sven cases in two widely separated bones have been documented (17,20), beginning with de Ga *et al* (17). Although osteochondroma and osteoid osteoma coexisted in the tibia in this case, there might be an etiological linkage between multiple osteoid osteomas and the coexistence of osteochondroma and osteoid osteoma.

Furthermore, marginal excision of the osteochondroma and CT-guided curettage of the osteoid osteoma on the proximal tibia and tibial shaft, respectively, were performed in this case, and the patient recovered from tibial pain immediately after surgery, even though during short-term follow-up. Although no recurrence of osteochondroma or osteoid osteoma was observed during short-term follow-up, the patient should undergo long-term follow-up to observe whether other bones with osteochondromas may develop osteoid osteoma in the future.

In conclusion, we described the first case of coexisting MO and osteoid osteoma, and marginal excision for osteochondroma and curettage for osteoid osteoma effectively improved the symptoms.

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Availability of data and materials

All data generated and analyzed during this study are included in this published article.

Authors' contributions

RK, HO, YA, KM, YT and KN conceived the study. RK, HO and YT contributed to the data acquisition. RK, HO, YA, KM, YT and KN wrote and edited the manuscript. HO and YT performed surgery and postoperative management, respectively. YT and KN revised the manuscript for intellectual content. RK and YT confirm the authenticity of all the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Patient consent for publication

Written informed consent for the publication and use of images was obtained from the patient and their guardians.

Competing interests

YT is on the editorial board of the Cancer Diagnosis and Prognosis. KN is on the editorial board of the Journal of Orthopaedic Research and is a board member of the International Society for the Study of Lumbar Spine.

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