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Ribbing disease: a case report and literature review

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Ribbing disease (RD) is a rare bone dysplasia characterized by benign endosteal and periosteal new bone formation confined to the diaphysis of the long bones of the lower extremities in young adults. The etiology and optimal treatment for the disease are unknown. It is often initially diagnosed as a low-grade osteomyelitis or a bone-forming neoplasia. It may also be confused with other causes of increased bone density. The onset is usually after puberty and the most common presenting symptom is pain that does not resolve with medical treatment and sometimes is intolerable. We report the case of a 22-year old woman with clinical and radiological manifestations of RD. In spite of different medical treatment modalities, pain did not resolve and the patient consulted multiple physicians. Intramedullary reaming of the tibia was performed to relieve the severe pain. To the authors' knowledge, in this report we present a case of RD for the third time in the orthopaedic literature and also she is the second case in the English literature to undergo a definite surgical treatment modality as intramedullary reaming for the solution of her pain. Owing to the rarity of the disease we aimed to report the complete findings of our encounter with the disease and to emphasize the role of an orthopaedic surgeon in consultation and intervention for the treatment of intolerable pain which is the most important symptom of this disease.

Key words: Pain/intramedullary reaming; Ribbing disease; sclerosing bone dysplasia.

Ribbing disease is a rare bone dysplasia characterized by the formation of exuberant but benign endosteal and periosteal new bone affecting the diaphysis of the long bones of the lower extremities in young adults. The etiology is still obscure and can easily be confused with other causes of increased bone density. It is often initially misdiagnosed. On imaging studies, it may simulate stress fracture, low-grade osteomyelitis, osteoid osteoma or a bone-forming neoplasia. It may also be confused with other sclerosing bone dysplasias and metabolic disorders.[1-4] Most of the time, RD is diagnosed by exclusion of other bone dysplasias.[4-7] This report provides the complete radiographic and histologic analysis of a patient with RD. To our knowledge, this is the most distinctive document for RD to date. As far as we are aware, twenty-two cases of RD have been previously reported in the English literature. Most of the reports were published in radiology, nuclear medicine or genetic journals. This is the third case in the orthopaedic literature and the twenty-third case in the English literature. However this is the second case in literature which has been treated intentionally with a surgical intervention for the distressing leg pain.

We report a case of RD in a 22-year-old woman with chronic pain in her left tibia who initially consulted multiple physicians and presented a diagnostic dilemma. Each suggested different diagnoses and treated her with antibiotics or nonsteroidal antiin-

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flammatory medication which did not resolve her pain. The clinical features, radiographic findings, histopathological examination and differential diagnosis have been discussed so that correct diagnosis can be made. The case is being reported not only for its rarity but also to alert the orthopaedic surgeons for keeping the possibility of this condition in mind as it can pose a diagnostic dilemma and also the treatment of the associated severe pain. Informed consent for publication of the data regarding this case was taken from the patient.

Case report

The patient, a 22-year-old-woman, was initially seen at another hospital for pain on the proximal left tibia with a six-month history. Plain radiographs demonstrated periosteal reaction which was suggested as a callus for a healing fracture (Fig. 1). The white blood-cell count and erythrocyte sedimentation rate were normal. The condition was interpreted as a healed stress fracture of the tibia and the patient was treated with anti-inflammatory drugs. There was no relief of the pain, so the patient consulted another orthopaedic surgeon at another hospital. Here, other imaging techniques along with a new plain radiographs were performed. Radiographs showed increased density and thickness of the proximal portion of the tibia diaphysis (Fig. 2). Computed tomography (CT) showed endosteal and periosteal cortical thickening (Fig. 3). Bone scans revealed increased tracer uptake in proximal tibial diaphysis (Fig. 4). Low-grade osteomyelitis was suspected. The patient was treated empirically with antibiotics. When the

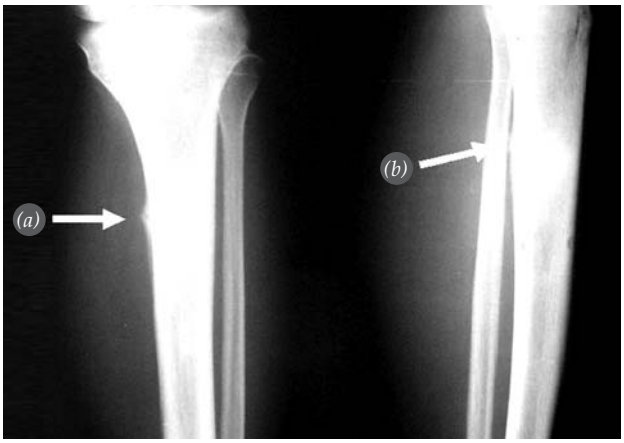

Fig. 1. Anteroposterior **(arrow a)** and lateral **(arrow b)** radiographs of the tibia, taken at the first hospital evaluation, demonstrates a periosteal reaction. This finding suggested a stress fracture of the tibia.

pain did not relieve and required increasing amount of analgesic to control the pain; the patient was referred to our institution.

The patient was admitted to our hospital with a history of distressing leg pain which did not respond to previous medical treatment and there was no history of trauma or overuse. She had no significant abnormal findings on a detailed physical examination. She only had minimal tenderness to palpation on the anterior aspect of the proximal tibia. There was no evidence of erythema or warmth over this area. She had no joint motion limitation. There was no distal neurovascular deficit. Her gait and the remainder of the musculoskeletal examination was normal. Medical and family history was unremarkable. We repeated the laboratory tests. Hematologic

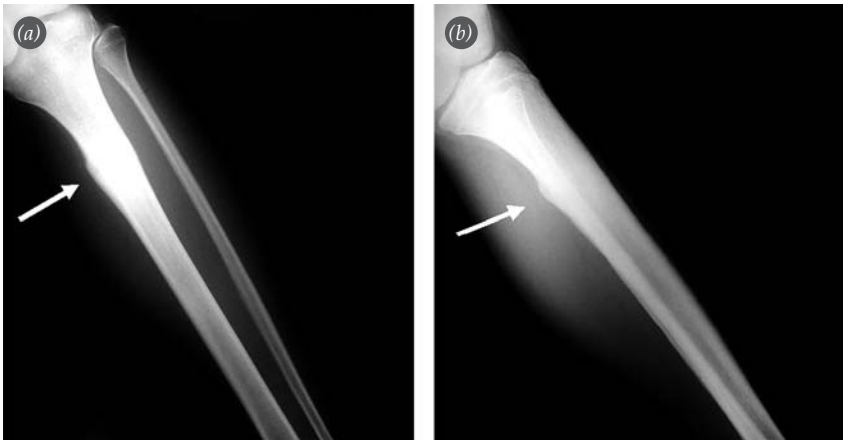

Fig. 2. **(a)** Anteroposterior and **(b)** lateral radiographs of the tibia, taken at the second hospital visit show increased density **(arrow a)** and thickness **(arrow b)** of the proximal portion of the tibia diaphysis.

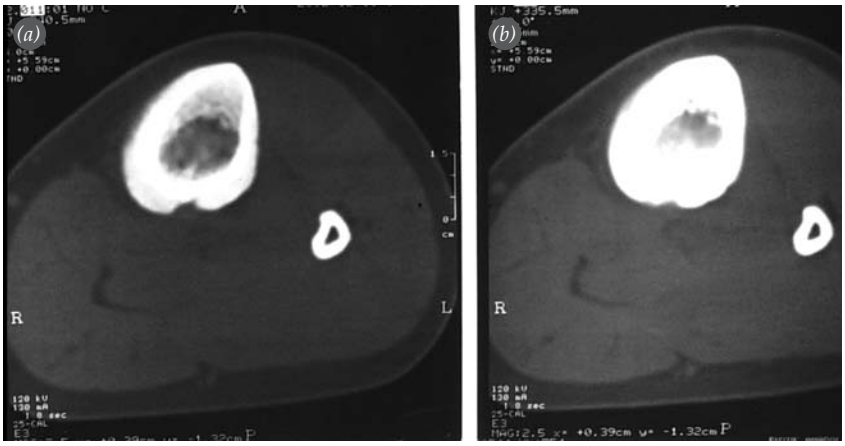

Fig. 3. Axial CT images of the proximal part of the tibia show periosteal and endosteal new bone formation.

investigations revealed a leukocyte count of 8200/mL with a sedimentation rate of 13 mm per hour (normal, 0-20 mm/hour). The C-reactive protein and bone-specific alkaline phosphatase, parathyroid hormone, ionized calcium, phosphorous, and 1,25 and 25-vitamin D were within normal limits. The physical examination and the laboratory findings were unremarkable. So we carefully evaluated the previous radiological investigations.

The plain radiographs demonstrated sclerosis with both endosteal and periosteal thickening of the proximal part of the tibial diaphysis (Fig. 2). The radiographs of the contralateral tibia and both femurs were normal. Technetium bone-scan revealed increased tracer uptake corresponding to the proximal portion of the affected tibia (Fig. 4). Transverse CT scans of the proximal portion of the tibial diaphysis showed endosteal thickening obliterating the medullary canal of the bone and periosteal thickening (Fig. 3). In addition to these radiological investigations we performed magnetic resonance imaging (MRI). Coronal MRI scans showed hypointense signal on T1-weighted images and hyperintense signal on T2-weighted images (Fig. 5). And also contrast-enhanced T1 weighted images showed the lesion as edema that was confined to the proximal portion of the tibial diaphysis (Fig. 5). With all these radiological interpretation it was difficult to suggest an infection or malignancy for the clinical situation, so we performed an open bone biopsy for the differential diagnosis. Histologic examination of the biopsy specimen showed cortical thickening and osteosclerosis. A slight increase in the number of osteocytes within the irregular and thickened trabeculae was also noted (Fig. 6). There was no evidence to diagnose malignancy or infection. No organisms grew on cultures of the biopsy specimen. The histopathologic findings and the result of cultures with the laboratory evaluation excluded the diagnosis of infection or a neoplastic disease. After all, we reviewed the literature for the reports describing the bone dysplasias and the treatment modalities for them. The diagnosis of RD was suggested, based on the case report by Beals et al.[1] it responded to intramedullary reaming, so we performed intramedullary reaming of the tibia as a separate surgical intervention to

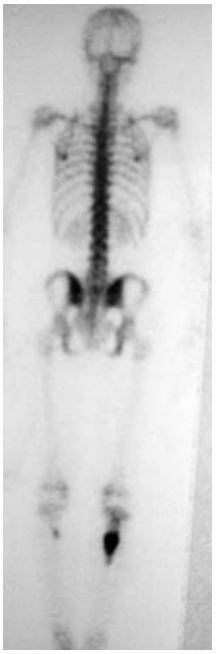

Fig. 4. Whole-body bone scan shows significant uptake within the proximal tibia, corresponding to the radiographic abnormality. No other foci of abnormal uptake were evident.

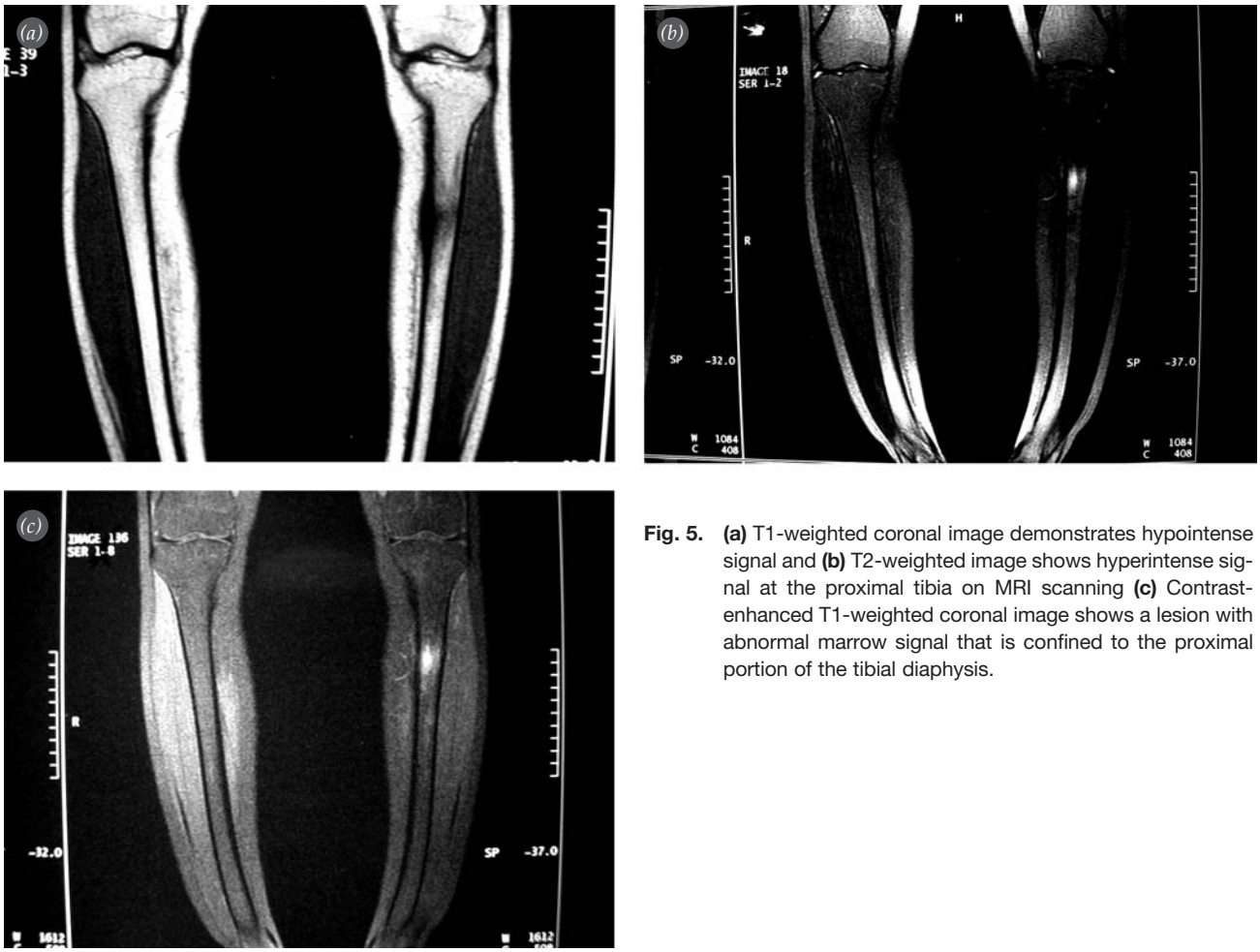

Fig. 5. **(a)** T1-weighted coronal image demonstrates hypointense signal and **(b)** T2-weighted image shows hyperintense signal at the proximal tibia on MRI scanning **(c)** Contrast-enhanced T1-weighted coronal image shows a lesion with abnormal marrow signal that is confined to the proximal portion of the tibial diaphysis.

relieve the pain. We opened the medullary canal proximal to the tibial tuberosity in the midline behind the patellar tendon. We tried not to be too distal for the entry site. Because the medullary canal was obliterated, it was difficult to locate the canal and we were very careful not to perforate the tibial cortex. We used reamers of increasing size to open the canal. After the operation the pain in the tibia resolved completely. Siblings of the patient were evaluated for the presence of RD to clarify its inheritance. There was no individual with the history of bone dysplasias in her family. At the time of the latest follow up, at the fifth year, the tibia was pain-free. The contralateral tibia and the both femurs were also pain-free.

Discussion

A disorder similar to the one observed in our patient was first described by Ribbing[4] in 1949. He reported the disorder in four of six siblings with diaphyseal involvement of the tibia and other long bones. He described a fusiform thickening of the diaphyseal cortex of the long bones with obstruction of the medullary canal. According to him although the exact onset of the disease was unknown, pain began at or after puberty. He observed that the disease progressed slowly and then stabilized.

Before the study of Seeger et al,[6] only thirteen cases of RD had been previously reviewed in the English Literature.[2,3,8-12] Seeger et al.[6] reported six unrelated women with RD involving the lower extremities in all patients. Of the 10 bones involved, lesions affected bilateral tibiae in three patients, a unilateral tibia in one. Beals et al.[1] reported a 32-year-old woman with lesions on bilateral tibiae and left femur. The onset of pain had been first in the left tibia, then pain subsequently developed in the right

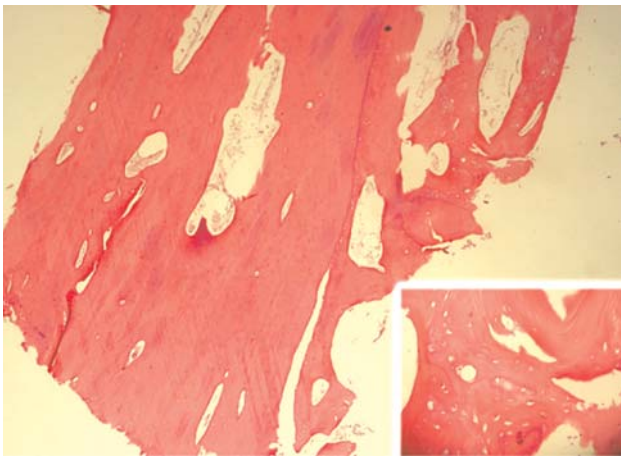

Fig. 6. Photomicrograph of the cortical biopsy specimen shows osteosclerosis, increased number of osteocytes per unit of the present bone (Stain, hematoxylin and eosin; objective magnification, x40, inset x125). [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

tibia and femur. This asynchronous involvement was also observed by Seeger et al.[6] in four patients with bilateral involvement. The time interval between the onset of pain and symptomatology at the second site was 19 to 96 months (mean, 46 months). But this asynchronous involvement and multiplicity of bones is not a general condition for RD. In patients reported by Seeger et al.[6] the lesions affected unilateral tibia in one and a unilateral femur in the other. Pain does not always accompany to the lesions. Lesions may also be discovered during the evaluation of the asymptomatic bones.[1,6]

RD is sometimes referred to as hereditary multiple diaphyseal dysplasia. The families studied by Ribbing[4] and by Paul[13] and one of the patients of Seeger et al.[6] had affected siblings, suggesting the possibility of recessive inheritance but it may not always be true as in our case and also as in the case described by Beals et al.[1] Although the environmental causes cannot be ruled out, the stimulus for periosteal and endosteal new bone formation is unknown. Greenspan[3] described RD as a dysplasia of intramembranous bone formation according to the classification of sclerosing dysplasias of bone.

The histopathologic findings most frequently described in patients with RD are cortical osteosclerosis with new bone formation. The histopathologic findings are not always distinctive to permit a diagnosis of RD on the basis of bone morphology alone. The diagnosis is established by consideration of the radiological findings and clinical features of the disease. Laboratory evaluation and biopsy does allow the exclusion of other diagnoses (malignancy, infection etc).[1,7]

There are many sclerotic bone disorders that can be confused with RD. In the patient who presents with unilateral increased density and thickness of the tibia, differential diagnosis includes osteoid osteoma, stress fracture, adamantinoma, fibrous dysplasia, osteosarcoma, melorheostosis, hyperphosphatasia, histiocytosis, lymphoma, intramedullary sclerosis and chronic sclerosing osteomyelitis. Bilateral increased density and thickness of the tibia may be associated with bone dysplasias such as Van Buchem and Worth endosteal hyperostosis, sclerosteosis, Camurati-Engelmann disease. There are metabolic and endocrine disorders that should also be considered. These are renal osteodystrophy, chronic vitamin A intoxication, pseudohypoparathyroidism and pseudopseudohyperparathyroidism, multifocal periostitis, prostaglandin E1 induced hyperostosis and Paget's disease.[1,5,6] Intramedullary osteosclerosis and Camurati-Engelmann disease are the two clinical conditions that are almost similar to RD in their radiological appearences.[9,14] They also show intense radiotracer uptake on bone scans. Nevertheless, differences in their clinical manifestations, laboratory findings, histologic features and the detailed evaluation of the radiological images lead to the diagnosis[1,2,5,8-11,14-21] (Table 1).

In spite of being aware of the characteristics of RD, clinical and radiological features do not always completely fit the diagnosis of a classical RD.[14] In the report of Beals et al.[1] axial CT of both tibiae demonstrated prominent endosteal thickening and narrowing of the medullary canal of the left tibia. Periosteal bone formation was not noticed. Although the results of the MRI and bone scans were described in the report, the visual figures were not provided. Periosteal and endosteal new bone formation is a classical description of RD. In the report of Ziran et al.[22] MRI, bone scans, CT scans and plain radiographs were demonstrated but however, the view of the histologic specimen was not included in the text. The report of Seeger et al.[6] did not include

Table 1. Comparison of clinical and radiological features of Ribbing disease, Camurati-Engelmann dysplasia and intramedullary sclerosis.

Ribbing	Intramedullary sclerosis	Camurati-Engelmann
Radiotracer uptake on bone scans (+)	Radiotracer uptake on bone scans (+)	Radiotracer uptake on bone scans (+)
Laboratory values normal	Laboratory values normal	Laboratory values normal
After skeletal maturity	At any age, female predominance	Presents during childhood
Unilateral or asymmetrically with asynchronous bilateral involvement	Unilateral or bilateral	Bilateral and symmetrical
Only in long bones, endosteal and periosteal reaction, on MRI bone marrow edema (+)	Intramedullary sclerosis within the middle or distal third of tibia and fibula, no periosteal reaction, on MRI bone marrow edema (-)	Metaphyseal involvement (Erlenmayer flask and valgus deformity of femur, skull, mandible, vertebrae, upper extremities, metatarsals, metacarps)
Histologically osteoblastic activity	Histologically osteoblastic activity	Histologically oteoblastic and osteoclastic activity
Gait and neurologic abnormalities, anemia (-)	Gait and neurologic abnormalities, anemia (-)	Gait and neurologic abnormalities, muscle weakness, anemia (+)
Progressive in young adults, may become static	Static	Continously progressive
Recessive inheritance? (not confirmed)	Nonhereditary, idiopatic	Dominant inheritance, gene chromosome 19q13

the MRI. MRI detection of bone marrow edema allows the differentiation of RD from intramedullary osteosclerosis.[23] To our knowledge although 23 cases have been reported in English literature, the other previous reports did not provide the all radiological and histological pictures of RD. In our case, radiographic finding was a fusiform thickening of the proximal portion of the tibial diaphysis. Although most of the lesions described in the literature are mid shaft thickening of the tibia, Ribbing[4] reported an involvement of the upper part of the tibia in one of his cases. The essential finding in this disease consists of a fusiform thickening of a portion of the diaphysis of a long bone. There is a tendency toward asymmetrical changes and to multiplicity of bones involved, with the tibia and femur most frequently affected. However the disease affected a unilateral tibia in one and a unilateral femur in one of the ten patients of Seeger et al.[6] Despite the atypical and unilateral localization of the lesion, the absence of an appropriate history of abnormal or unaccustomed stresses due to the vigorous activities and the essential finding of a fusiform thickening excluded the diagnosis of a stress fracture in our patient. In addition, there was no risk factor as a sudden increase in training of a sporting activity or anatomical and physiological variations, such as leg length discrepancies, knee alignment, foot anomalies and abnormal bone geometry that could be linked to the development of stress fractures.[24,25] The CT of our patient shows both endosteal and periosteal bone formation which is distinctive for RD. The complete findings of our patient are presented with images to constitute a clear description of RD.

Although the pain does not always accompany the lesions, pain is the most common clinical symptom encountered in RD.[1,3,6] There is a variability in the natural history of the pain, with most cases reported to stabilize with time. Asymptomatic patients have also been described and some patients have pain at only one of several affected bones, but if it occurs it is sometimes very distressing for the patient.[1,21] The pain of our patient was dull and worsened by physical activity. According to the patient's history, the intensity of the pain increased with time. This mode of the patient's pain differed from the others' in the literature. The pain of the patient in the report of Beals et al.[1] was constant and also the pain of the patient reported by Ziran et al.[22] resolved with time in the absence of any further specific treatment after oral pamidronate. There are no established medical or surgical treatments for RD. Ziran et al.[22] have treated his patient who was diagnosed as RD with oral pamidronate. They had expected a relief for the pain depending on the effect

of pamidronate in decreasing bone pain in a number of diseases as osteolytic bone metastases, fibrous dysplasia and Paget's disease. However there was a lack of response to pamidronate. The case reported by Fallon et al.[2] included creating a cortical window and curettage of the medullary canal and this resulted in immediate pain relief. But they did it as a bone biopsy, it was not a separate surgical intervention to relieve the pain. In the case described by Beals et al.[1] following intramedullary reaming, there was a dramatic pain relief in both the femur and the tibia. In our patient, after removal of sclerotic endosteal bone by intramedullary reaming, we also observed a complete pain relief. The tibial pain, which the patient rated as 9 on a visual analog scale of 0 to 10 preoperatively, was rated as 0 following the intramedullary reaming. Reaming of the medullary canal seems to be only treatment modality in RD where other methods like medical treatment fails to relieve the pain completely. Removal of the sclerotic bone by intramedullary reaming may explain this pain relief. Bone marrow edema may also be responsible for the pain. Detailed explanations should be found to interpret this pain relief after reaming and also a hypothesis for the pathogenesis of RD.

In conclusion, orthopaedic surgeons should be aware of the sclerosing bone dysplasias in which the diagnosis is made on the basis of characteristic radiological and clinical manifestations rather than the histopathology of the lesion. RD is a distinct and rare bone dysplasia. When RD is suspected, additional radiological investigations should be performed. A bone scan should be done to ascertain the extent of involvement. Other individuals of the family should also be evaluated for the presence of the disease. Laboratory evaluation and biopsy is usually indicated for the differential diagnosis. Histopathological findings are nonspesific but assist in excluding other diagnoses. If severe pain exists and does not resolve with time, orthopaedic surgeons should be alert to the fact that it may only be relieved by intramedullary reaming of the affected long bones. An orthopaedic surgeon plays the main role in relieving this distressing pain which is the only clinical finding of the disease. In the future, genetic studies will be helpful to clarify the inheritance and pathogenesis of this very rare bone dysplasia.

Conflicts of Interest: No conflicts declared.

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