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# Radiologic Findings in Polyarticular Amyloid Arthropathy and Myopathy in Multiple Myeloma: A Case Report

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Study Design A  
Data Collection B  
Statistical Analysis C  
Data Interpretation D  
Manuscript Preparation E  
Literature Search F  
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**Conflict of interest:** None declared

**Patient:** Male, 56  
**Final Diagnosis:** Amyloid arthropathy and myopathy  
**Symptoms:** Polyarthralgia  
**Medication:** —  
**Clinical Procedure:** —  
**Specialty:** Radiology





**Objective:** Rare disease  
**Background:** Amyloid arthropathy and myopathy are complications of amyloidosis that can be associated with non-specific imaging findings, which may be challenging to interpret. The report is of a case of polyarticular amyloid arthropathy and myopathy in a 56-year-old man with multiple myeloma and includes a description of the radiographic, computed tomography (CT), and magnetic resonance imaging (MRI) findings.

**Case Report:** A 56-year-old man with multiple myeloma presented with chronic polyarticular pain and swelling. Soft tissue thickening of the wrist and knee were found on MRI to be of intermediate T1 weighted imaging (T1WI) and low to intermediate T2 weighted imaging (T2WI) signal intensity. Denervation muscle edema seen in the thenar muscles on the MRI of the right wrist were associated with carpal tunnel syndrome secondary to amyloid deposition. Soft tissue lesions in the periarticular regions of both hip joints were contiguous with subchondral bone lesions. Diffusely scattered myeloma lesions were shown as hyperintense on short tau inversion recovery (STIR) MRI imaging throughout the appendicular and axial skeleton, with vertebral compression fractures. Bilateral iliopsoas involvement with hypertrophy and abnormal surrounding fat reticulated signal intensity was consistent with amyloid myopathy. The patient had a pathological fracture of the right femoral neck and underwent surgical fixation. Histology of the right femoral head confirmed amyloid deposits.

**Conclusions:** Because the clinical presentation and imaging findings of musculoskeletal amyloidosis can be nonspecific, they can result in delay in diagnosis and treatment. Early radiologic identification of polyarticular amyloid arthropathy and myopathy should prompt confirmatory biopsy to confirm the diagnosis.

**MeSH Keywords:** Amyloid • Amyloidosis • Multiple Myeloma

**Full-text PDF:** <https://www.amjcaserep.com/abstract/index/idArt/911212>

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## Background

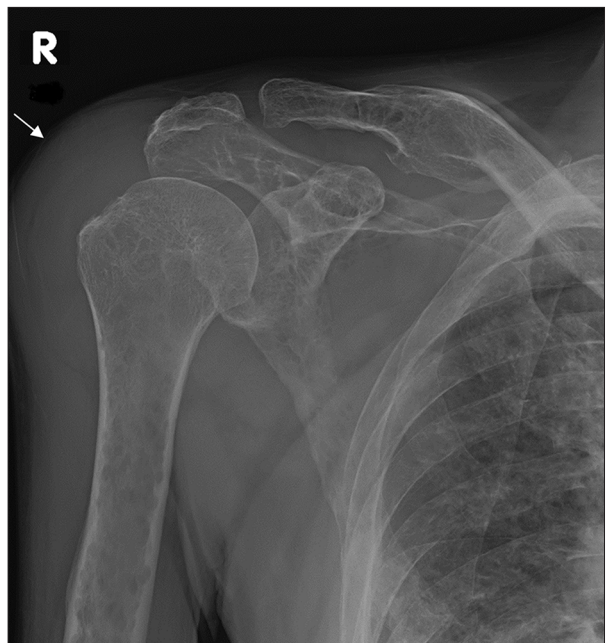
Amyloidosis is characterized by the extracellular deposition of amyloid protein and protein derivatives, and can be localized to single organs, or can be systemic. Amyloid proteins possess an affinity for Congo red histochemical staining by light microscopy and demonstrate apple-green birefringence when viewed under polarized light microscopy. The Nomenclature Committee of the International Society of Amyloidosis classifies amyloidosis based on the fibril protein of the amyloid deposit. Primary amyloidosis is caused by the accumulation of monoclonal immunoglobulin light chains (or, more rarely, heavy chains) and is termed amyloid light chain (AL) amyloidosis [1,2]. Primary amyloidosis is associated with monoclonal plasma cell dyscrasias, including multiple myeloma. Secondary amyloidosis is characterized by the accumulation of the acute phase protein serum amyloid A (SAA), and is associated with chronic inflammatory conditions, including Reiter's syndrome, ankylosing spondylitis, Crohn's disease, and rheumatoid arthritis, chronic infection, including tuberculosis and chronic osteomyelitis, and malignant disease, including renal cell carcinoma, and Hodgkin's disease [1–3]. Amyloidosis due to the accumulation of beta-2 microglobulin occurs in patients with chronic renal failure on long-term hemodialysis.

Amyloid deposition may occur in various organs, including the gastrointestinal tract, heart, lungs, and skin. Involvement of the musculoskeletal system is not uncommon although these patients are rarely symptomatic [1]. There are varied and non-specific imaging findings in amyloid arthropathy and myopathy, which may present a diagnostic challenge to radiologists. We present a case of polyarticular erosive amyloid arthropathy and myopathy with a review of the literature and description of the imaging findings.

## Case Report

A 56-year-old man was referred to the hematology service in our center for the management of newly diagnosed multiple myeloma (IgG lambda). The diagnosis was confirmed with bone marrow aspiration and trephine biopsy and histology. The patient was subsequently commenced on chemotherapy. He gave a history of long-standing polyarticular pain and swelling, involving the shoulders, wrists, hips, and knees. There was no history of trauma. The patient underwent left hemicolectomy for a stage T1 N1 M0 descending colon tumor a year previously. Other significant co-morbidities included chronic kidney disease, rheumatic heart disease, and hypertension.

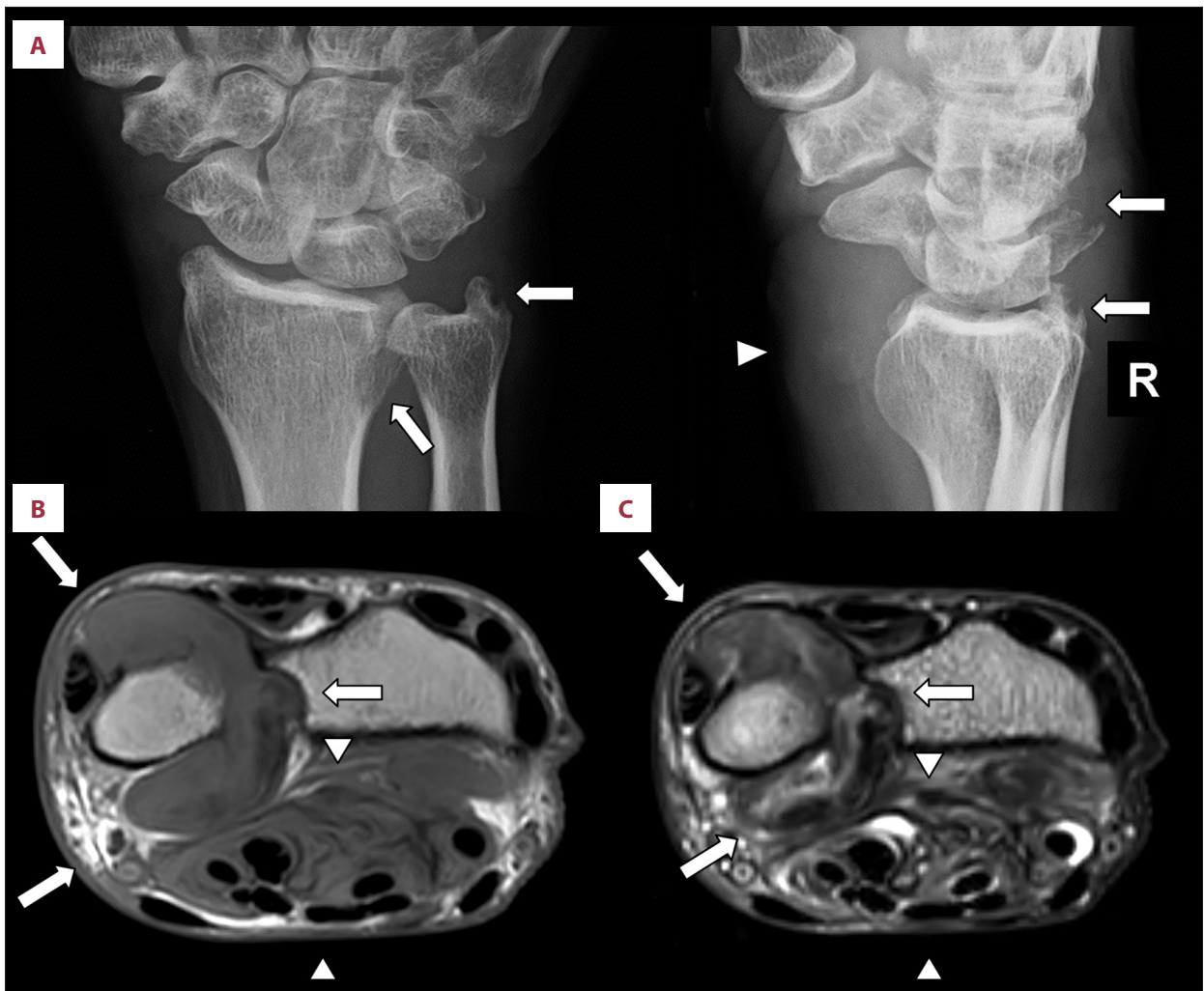
The patient's vital signs were stable. There were prominent bilateral firm soft tissue swellings in the shoulders and wrists. Examination of the hands showed wasting of the thenar



**Figure 1.** Plain radiograph of the right shoulder of a 56-year-old man with multiple myeloma. Plain radiograph of the right shoulder shows multiple lytic lesions, compatible with multiple myeloma. Note the prominent soft tissue overlying the right deltoid muscle (arrow), in keeping with the 'shoulder-pad' sign of amyloid deposition in the shoulder musculature. There is a healed right clavicular shaft fracture.

eminences with decreased sensation in both thumbs, index fingers, and middle fingers. Tinel's and Phalen's signs were positive in both hands. These findings were consistent with bilateral carpal tunnel syndrome. The patient was anemic with a hemoglobin level of 8.4 g/dL. Autoimmune markers, including antinuclear antibody (ANA), rheumatoid factor (RF), and anti-cyclic citrullinated peptide (anti-CCP) antibody were negative.

Initial assessment of the affected joints with plain radiographs showed multiple lytic lesions, compatible with multiple myeloma. Radiograph of the right shoulder showed prominent soft tissue overlying the right deltoid muscle, in keeping with the 'shoulder-pad' sign of amyloid deposition in the shoulder musculature (Figure 1). There were bony erosions in the right wrist involving the distal radio-ulnar joint, ulnar styloid process, and carpal bones with surrounding soft tissue thickening, which was more prominent over the volar aspect (Figure 2A). Magnetic resonance imaging (MRI) of the right wrist showed diffuse intermediate T1 weighted imaging (T1WI) and low to intermediate T2 weighted imaging (T2WI) signals with nodular synovial soft tissue thickening and subchondral erosive changes around the carpal bones, in the radio-carpal, ulnar-carpal, and distal radio-ulnar joints (Figure 2B, 2C). Diffuse soft tissue thickening was seen in the carpal tunnel surrounding the flexor tendons with denervation-related muscle edema



**Figure 2.** Plain radiograph and magnetic resonance imaging (MR) of the wrist of a 56-year-old man with multiple myeloma. (A) Plain radiograph of the right wrist shows bony erosions in the right wrist involving the distal radio-ulnar joint, the ulnar styloid process, and the carpal bones (arrows) with surrounding soft tissue thickening, which is more prominent over the volar aspect (arrowhead). Magnetic resonance imaging (MRI) with selected T1 weighted imaging (T1WI) (B), and T2 weighted fat-suppressed imaging (T2WI) (C) of axial sections of the right wrist shows diffuse intermediate T1W and low to intermediate T2W signal nodular soft tissue thickening around the distal ulnar and within the distal radio-ulnar joint (arrows). Soft tissue thickening is also seen in the carpal tunnel surrounding the flexor tendons (arrowheads).

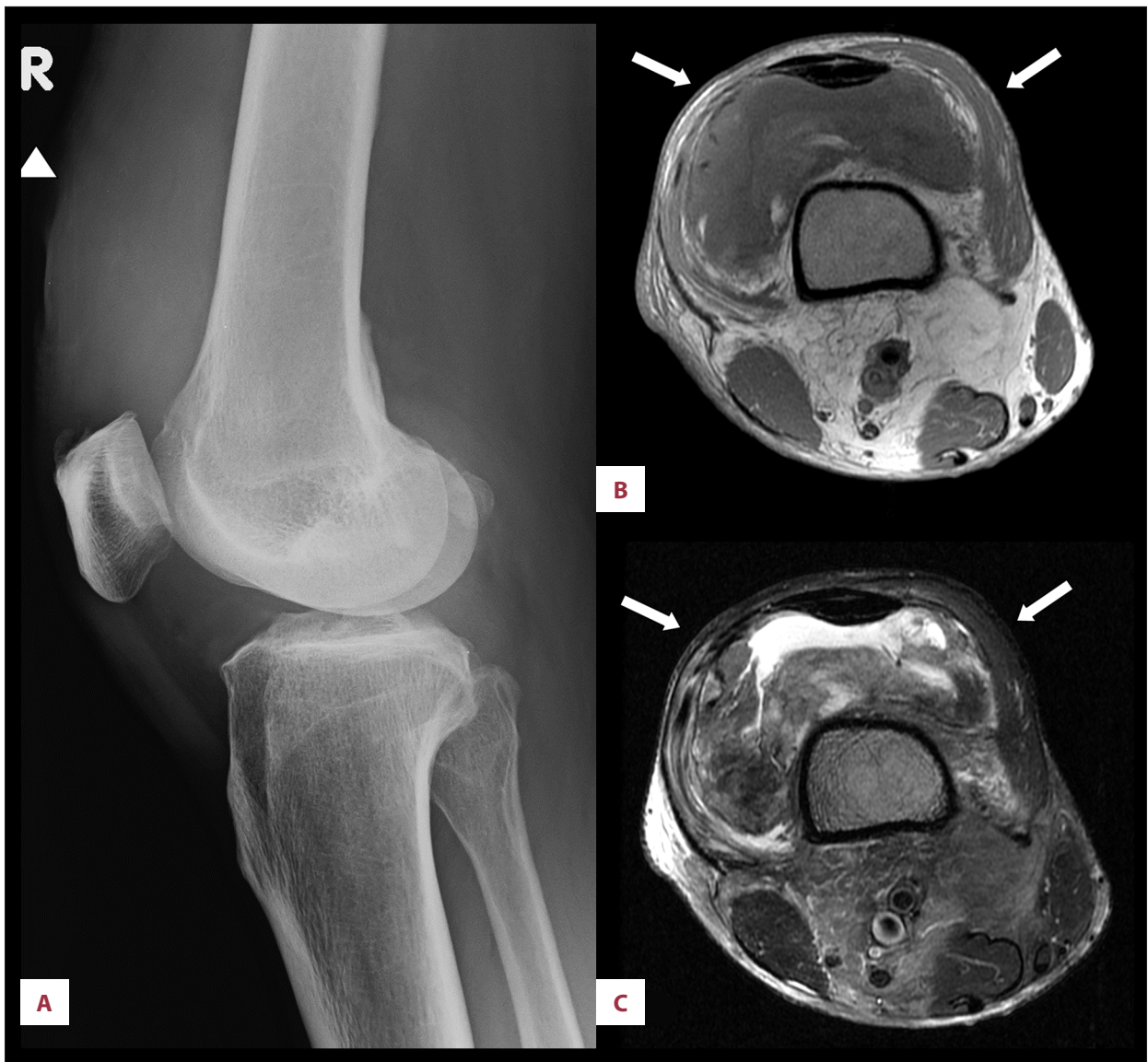
in the thenar muscles seen on MRI of the right wrist, which was related to carpal tunnel syndrome secondary to amyloid deposits.

Radiography of the right knee showed soft tissue thickening in the suprapatellar region (Figure 3A). On MRI, the soft tissue thickening was related to diffuse nodular synovial thickening demonstrated by intermediate T1W and low to intermediate T2W signal intensity, with a suprapatellar effusion (Figure 3B, 3C). Radiography of the pelvis showed multiple lytic lesions in both iliac bones and proximal femora, compatible with multiple myeloma (Figure 4A). Computed tomography (CT) of the pelvis showed periarticular erosive

changes involving both femoral heads, with lytic lesions in the proximal femora and visualized iliac bones (Figure 4B). MRI of the pelvis showed extensive bone marrow infiltration associated with multiple myeloma. There was bilateral iliopsoas involvement with hypertrophy and surrounding subcutaneous fat reticulation, consistent with amyloid myopathy (Figure 5).

The patient experienced worsening right hip pain and was unable to ambulate. Further evaluation with plain radiographs and MRI of the pelvis showed a pathological fracture of the right femoral neck. The patient underwent surgical fixation of the pathological fracture with a bipolar hemiarthroplasty with a long femoral stem. Histology of the right femoral head





**Figure 3.** Plain radiograph and magnetic resonance imaging (MR) of the right knee of a 56-year-old man with multiple myeloma. (A) Lateral view of the plain radiograph of the right knee. There is soft tissue thickening in the suprapatellar region (arrow). Magnetic resonance imaging (MRI) with selected T1 weighted imaging (T1WI) (B), and T2 weighted fat-suppressed imaging (T2WI) (C) of axial sections of the right knee at the suprapatellar region shows diffuse nodular synovial thickening demonstrating intermediate T1W and low to intermediate T2W signal intensity (arrows) and a suprapatellar effusion.

showed extracellular amorphous, eosinophilic deposits with a salmon pink appearance on Congo red histochemical staining and apple-green birefringence when viewed under polarized light, in keeping with amyloid deposits (Figure 6).

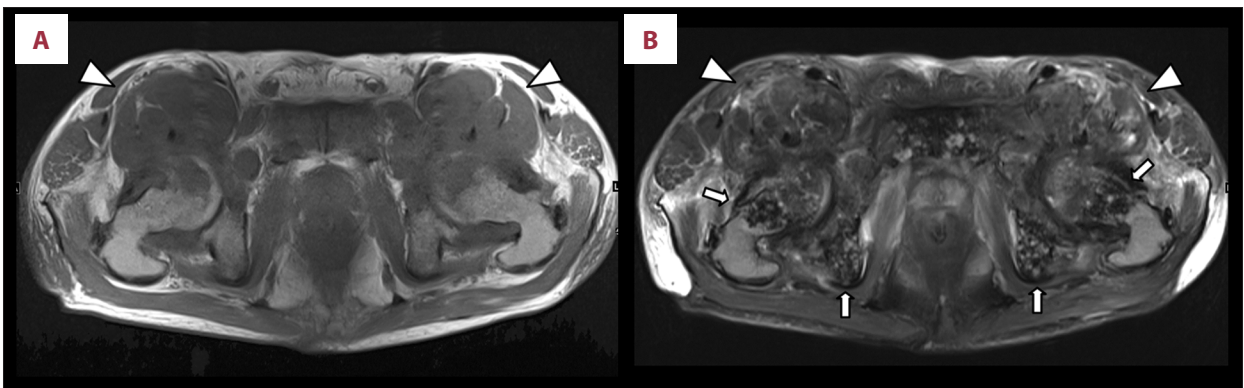
Initial postoperative recovery was uneventful. However, the patient subsequently suffered a pathological fracture of the contralateral hip that required surgical fixation with a bipolar hemiarthroplasty. Histology of the left femoral head also showed the presence of amyloid deposits. The patient underwent rehabilitation after surgery with treatment for multiple myeloma.

## Discussion

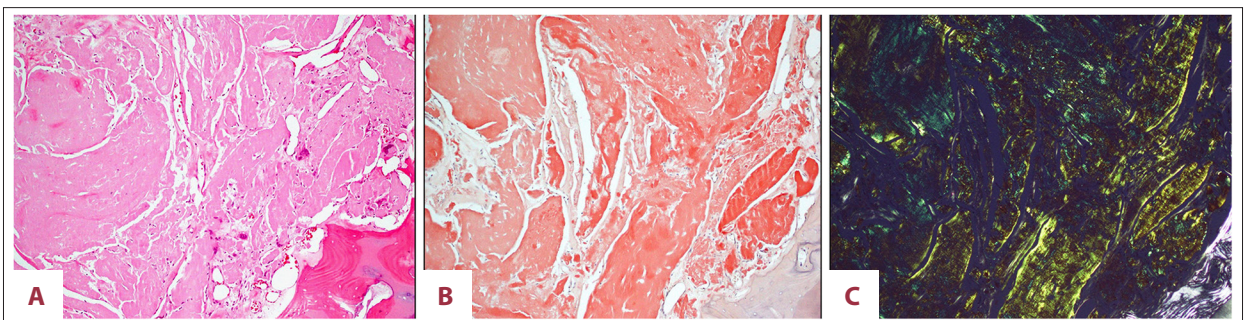
Amyloid deposition becomes clinically significant when its diffuse form affects organ function, or its rarer focal form creates a mass effect, also known as an amyloidoma [2]. Amyloidosis involving the musculoskeletal system is not uncommon as 3.7% of patients with amyloidosis develop amyloid arthropathy [4]. In 2007, Prokaeva et al. reported a 3.9–4.3-fold increase in the risk of developing soft tissue and bone involvement in patients with AL amyloidosis with multiple myeloma, compared with individuals without multiple myeloma. Clinical symptoms



**Figure 4.** Plain radiograph and axial computed tomography (CT) of the pelvis of a 56-year-old man with multiple myeloma. (A) Plain radiograph of the pelvis shows multiple lytic lesions in both iliac bones and proximal femora, compatible with the known diagnosis of multiple myeloma. Loss of L5 vertebral height is compatible with a compression fracture. (B) Selected axial computed tomography (CT) section of the pelvis showed periarticular erosive changes involving both femoral heads (arrows) with lytic lesions in the proximal femora and visualized iliac bones.



**Figure 5.** Magnetic resonance imaging (MRI) of the pelvis of a 56-year-old man with multiple myeloma. Magnetic resonance imaging (MRI) with selected T1 weighted imaging (T1WI) (A) and T2 weighted fat-suppressed imaging (T2WI) (B) axial sections of the pelvis showed extensive bone marrow infiltration related to multiple myeloma (arrows). There is bilateral iliopsoas involvement with hypertrophy and subcutaneous fat reticulation, compatible with amyloid myopathy (arrowheads).



**Figure 6.** Photomicrographs of the light microscopy and polarized light microscopy of amyloid in sections of bone of a 56-year-old man with multiple myeloma. (A) Light microscopy shows amorphous eosinophilic deposits present within the femoral head. Hematoxylin and eosin (H&E). Magnification  $\times 100$ . (B) Light microscopy with Congo red histochemical staining shows salmon pink deposits, characteristic of amyloid. Congo Red. Magnification  $\times 100$ . (C) Polarized microscopy of the Congo red histochemical staining shows apple-green birefringence of the deposits, consistent with amyloid. Congo Red. Magnification  $\times 100$ .

resulting from amyloid deposition are rare and are often masked by chronic inflammatory conditions, such as rheumatoid arthritis [1]. Amyloid arthropathy is more commonly seen in older patients, which can distinguish it from rheumatoid arthritis. In 2013, a systematic analysis of 101 reported cases concluded that amyloid arthropathy associated with multiple myeloma was predominantly a non-erosive symmetric polyarthritides, with erosive articular changes only occurring in five cases [5]. The patient in the present report presented with erosive symmetric polyarthritides demonstrated by bilateral hip joint involvement.

Amyloid arthropathy commonly affects the shoulders, wrists, elbows, hips, and knees and may present with swelling, arthralgia, and carpal tunnel syndrome [1]. Carpal tunnel syndrome has been reported to occur in 13.1% of patient with amyloidosis [4]. Amyloid infiltration of the muscles causes pseudohypertrophy, chronic pain, and weakness, which usually occurs in the shoulder girdle giving an impression of well-developed shoulder musculature, termed the 'shoulder-pad' sign [2]. This sign was evident in the patient reported in this case (Figure 1) and has been described to be pathognomonic for light chain amyloidosis and may be a clue to the diagnosis [6]. On a plain radiograph, findings of amyloid arthropathy are similar to an erosive arthropathy due to the presence of subchondral erosions and juxta-articular osteoporosis [1]. Periarticular soft tissue masses correlating with nodular synovial hypertrophy are often seen, and amyloidosis with bony involvement demonstrate lytic lucency within the cortical or medullary bone, usually with fine sclerotic margins, often located in the periarticular bone and at the site of ligamentous insertions [7]. Bony metastases and deposits of multiple myeloma are other differential diagnoses, although these do not show a periarticular predilection. In patients on long-term hemodialysis, brown tumor of secondary hyperparathyroidism should also be considered.

On MRI, amyloid arthropathy and bursitis show diffuse nodular synovial thickening with low signal intensity on T1 weighted imaging (T1WI) and T2 weighted imaging (T2WI) sequences [1,7-9]. Mild peripheral enhancement is seen around these nodular low signal intensity masses following administration of intravenous gadolinium. Differential diagnoses include gout, pigmented villonodular synovitis, and hemophilia, which also demonstrate low signals on fluid-sensitive sequences [7,9].

Amyloidoma involving the bone can simulate a neoplasm causing cortical thinning and erosions and demonstrates low

to intermediate T1W signals with gadolinium enhancement and low T2W signals, which is different from the high signal intensity on T2W sequences seen with chondromas, chondrosarcomas, and myelomatous lesions [1]. When subcortical, amyloidoma may extend into the joint cavity or surrounding bursa [3,7]. In 2005, Kiss et al. also described variable T2W signal intensity ranging from hypointensity to hyperintensity, probably related to the combination of amyloid deposits and fluid collection within the subchondral lesion. Amyloidosis involving the muscle results in marked hypertrophy and has a reticular appearance, related to myopathy seen in the surrounding subcutaneous fat, differentiating it from other neuromuscular conditions, and is better appreciated on the T2W MRI sequence [1,10]. Pseudohypertrophy of skeletal muscles resulting from amyloid deposition has been reported to occur in 1.6% of patients with amyloidosis [4]. Amyloid myopathy commonly presents with proximal muscle weakness and raised creatine kinase levels and is often mistaken for an inflammatory myopathy [11]. In addition to treating the underlying condition, which in this case was multiple myeloma, symptomatic amyloid arthropathy can be managed conservatively with physiotherapy, anti-inflammatory medications, corticosteroids injections, or it can be treated surgically by radiosynovectomy and arthroplasty [3,5].

## Conclusions

The clinical presentation and imaging findings of amyloidosis are often nonspecific and should be considered in patients with chronic inflammatory conditions, on long-term hemodialysis, and patients with multiple myeloma. Periarticular erosions associated with diffuse nodular synovial thickening with low to intermediate T1 weighted imaging (T1WI) and T2 weighted imaging (T2WI) signals on magnetic resonance imaging (MRI) may suggest a diagnosis of amyloid arthropathy in the right clinical setting. Amyloid myopathy is associated with muscle hypertrophy with subcutaneous fat reticulation on fluid-sensitive MRI sequences, which is often associated clinically with induration of the extremities. Early radiologic identification of polyarticular amyloid arthropathy and myopathy should prompt a confirmatory biopsy to confirm the diagnosis.

## Conflict of interest

None.



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