Unveiling a Hidden Culprit in Hip Pain: Hydroxyapatite Deposition Disorder in the Gluteus Medius Tendon

Lachlyn Keiller[1]*, Tuan Phan[1,2]

[1]*Department of Radiology, Peninsula Health, Victoria, Australia*
[2]*School of Translational Medicine, Monash University, Victoria, Australia*

***Correspondence:** Dr Lachlyn Keiller, Department of Radiology, Peninsula Health, 2 Hastings Road, Frankston, Victoria 3199, Australia, Tel: +61 452 629 082

lachlyn.keiller97@gmail.com

Radiology Case. 2025 January; 19(1):1-7 :: DOI: 10.3941/jrcr.5541

Authors' Contributions
Lachlyn Keiller – patient care and contact, research and manuscript writeup
Tuan Phan – manuscript editing and corrections, diagnostic imaging assistance

Patient Consent
We confirm that written, informed consent was obtained for publication of this case from the patient being discussed. The consent form has been signed by the patient and if required can be submitted to the Journal as evidence.

Ethical Statement
The authors declare that they have obtained informed consent from the patient discussed within this case report. The authors declare that they have taken all reasonable steps to de-identify the patient discussed within this case report. The authors declare that ethics approval was obtained from the Peninsula Health Human Research Ethics Committee.

Conflict Of Interest Statement
The authors have no conflicts of interest or competing interests to disclose.

ABSTRACT

Hydroxyapatite deposition disorder (HADD) is a spectrum of conditions that can manifest as calcific tendinitis, peri-articular hydroxyapatite deposition, and hydroxyapatite-induced arthritis, often presenting diagnostic challenges due to its rare occurrence and non-specific symptoms. We report on an unusual case of HADD located in the gluteus medius tendon, highlighting the complexities encountered in diagnosis and the effective management strategies employed. Through a meticulous review of the patient's clinical presentation, imaging findings, and treatment response, we underscore the necessity of considering HADD in differential diagnoses for hip and other joint pain, especially in atypical locations. We propose a diagnostic pathway for HADD in the differential diagnosis for patients presenting with hip pain, and reinforce the importance of a multidisciplinary approach in managing such complex cases.

CASE REPORT

BACKGROUND

HADD is a rare musculoskeletal condition characterized by deposition of calcium hydroxyapatite within various areas of the body. Owing to its rare occurrence, few cases have been published in the literature since its first description in 1907. In light of its rarity, we present here a case of HADD of the gluteus medius tendon, and propose a diagnostic pathway for HADD, whilst reinforcing the effectiveness of a multidisciplinary approach to its management.

CASE REPORT

A 52-year-old female presented to the emergency department with a two-day history of right-sided hip pain primarily centered around the right buttock and radiating to the right foot. The pain was associated with cramping around the right buttock, and a reduced ability to weight-bear on the right hip. She denied any history of recent trauma, subjective fevers, neurological symptoms, or bowel/bladder incontinence.

Initial examination revealed unremarkable vital signs, with a tender right hip, particularly around the lateral aspect of the joint, and concomitant weakness in hip flexion/extension and hip internal/external rotation. There was no evidence of swelling or overlying skin changes around the right hip. Her urine dipstick was normal. Her blood tests were remarkable for significant anaemia (Haemoglobin 69 g/L), elevated gamma-glutamyl transferase (481 units/L) and hypoalbuminaemia (25 g/L), with all other parameters within normal limits.

She has a past medical history of alcoholic liver cirrhosis and chronic back pain. Her back pain is secondary to a previous injury, which resulted in an L5-S1 disc herniation affecting the exiting nerve root, as diagnosed on an MRI of the lumbosacral spine ten years prior.

A CT scan of her lumbosacral spine at presentation revealed a hazy, poorly defined calcification of the right gluteus medius tendon insertion at the lateral aspect of the greater trochanter, without evidence of fracture or osseous lesions (Figure 1).

Rheumatology consultation led to a treatment plan including commencement of oral non-steroidal anti-inflammatories (NSAIDs) and a brief course of oral prednisolone. This was followed by an ultrasound-guided cortisone injection into the patient's right gluteus medius tendon, which resulted in a significant reduction in her hip pain, and improved her ability to ambulate. Although the patient initially faced challenges with physiotherapy while hospitalised, she managed to effectively use crutches at the time she was discharged. Just three weeks after leaving the hospital, she was able to walk without any assistance. Her condition further improved after receiving a second steroid injection two months post-initial treatment, which greatly diminished her hip pain, and notably improved her quality of life.

The collaborative, multidisciplinary treatment approach utilised in our case was very effective, combining medical and physiotherapy. This case also suggests that closely monitoring patients for any recurrence of symptoms is crucial, indicating the potential benefits of employing a mixed regimen of drug therapy and rehabilitation exercises.

DISCUSSION

Aetiology and Demographics

HADD is a rare condition of unclear aetiology and incidence, which results in peri- and intra-articular calcium hydroxyapatite (CHA) deposition [1]. HADD has a significant female predominance, most commonly occurring between the fourth and sixth decades of life [1]. While HADD has previously been recognised as a cause of hip pain [2], its predominant demographic makes it a less-often considered differential diagnosis for this presentation.

The underlying aetiology of HADD remains uncertain, despite the literature presenting several cases since its first description by Painter in 1907 [1, 3]. CHA is the commonest form of calcium in human bone, and the commonest precipitant in pathological calcification throughout the body [4]. Four disparate theories have been proposed to contribute to HADD's development: 1) degenerative calcification resulting from repeated trauma and vascular ischaemia; 2) chondrocyte-mediated calcium deposition; 3) an analogous process to endochondral ossification, or; 4) erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts [1, 4]. Both vascular ischaemia and repetitive trauma produce localised inflammatory responses, each of which in turn result in calcium deposition within soft tissues [5].

Despite its unclear aetiology, metabolic disorders and genetic predispositions have been identified for HADD. There appears to be a strong association between HADD and diabetes, thyroid disorders, and disorders of oestrogen metabolism [6]. The exact pathophysiological mechanism linking thyroid disorders and HADD remain unclear, however, given the widespread metabolic effects of thyroid hormone, the two disorders are likely linked by some aspect of calcium metabolism [7, 8]. Furthermore, the established link between oestrogen and calcium metabolism in bone may provide some insight into the female predominance of HADD, insofar as oestrogen imbalance may contribute to deposition of CHA within soft tissues [5]. Furthermore, HLA-A1 genotypes appear to have an association with the development of HADD. Of note is the HLA-A1-HADD genotype, the presence of which suggests a further immunological predisposition to HADD development, which presently remains unclear [5].

Imaging Findings

Despite the mimicry of HADD for other diseases, the imaging findings associated with the condition provide significant utility in its diagnosis. In particular, owing to the radiopaque nature of CHA, plain radiographs often demonstrate poorly defined densities within soft tissues, adjacent to joints [9]. Advanced cases of HADD can also demonstrate bony erosions and cortical degeneration [9]. Furthermore, ultrasound will often demonstrate hyperechoic foci of calcification with some degree of acoustic shadowing, depending upon the stage of the disease, and resultant form of calcification observed [10].

In this case, the decision to utilise computed tomography (CT) as the imaging modality was due to its exceptional capability to visualise calcific deposits within the gluteus medius tendon. These deposits, which are often situated near bony structures, can sometimes show signs of inflammation in the surrounding tissues [4]. This imaging choice was strongly supported by the distinct characteristics of the patient's presentation and her comprehensive clinical history. CT scans are particularly adept at identifying the high-density calcifications typical of hydroxyapatite, which absorb X-rays more than the adjacent soft tissues due to their substantial calcium content [11]. This feature, combined with the patient's clinical presentation and laboratory findings, guided the diagnostic pathway towards

HADD, effectively ruling out other possible sources of hip pain. Additionally, the presence of oedema adjacent to the calcific deposits – indicated by the relative hypodensity of the inflamed surrounding tissues on the CT scan – further reinforces the diagnosis of HADD [4], highlighting the diagnostic importance of this imaging technique in the evaluation of suspected cases. Given the significant correlation between HADD and inflammatory changes, imaging findings often differ depending upon the stage of the disease within which a radiological study is performed [5].

Differential Diagnosis

The challenge of accurately diagnosing HADD lies in its symptoms, which closely mirror those of several other joint conditions, often leading to misdiagnosis. For instance, without specific imaging, HADD could be mistakenly attributed to trauma-induced joint pain, particularly if the patient's medical history suggests recent injury [5]. Moreover, HADD is just one of many potential diagnoses for acute joint pain, which also includes septic arthritis, chronic joint infections, pseudo-hyperparathyroidism, hyperparathyroidism, calcium pyrophosphate deposition disease (CPPD)/chondrocalcinosis, and gout [5]. To distinguish HADD from these conditions, clinicians must rely on characteristic imaging patterns. For instance, while HADD typically presents with diffuse calcifications adjacent to joints, chronic infections usually result in intra-articular calcifications, and CPPD is marked by more defined calcific deposits, often in the knees and wrists [5]. Recognizing these distinct patterns is crucial for steering the diagnostic process towards the correct condition [5]. Table 1 provides a summary of various factors which aid in the differentiation of HADD from other conditions which it mimics, and acts as a diagnostic pathway.

Management of HADD involves a spectrum of strategies, ranging from conservative measures to more aggressive interventional and surgical options, depending on the stage (acute/chronic), severity, and progression of the disease [12]. Initial treatment often starts with NSAIDs to leverage their anti-inflammatory effects, complemented by rest and targeted physiotherapy to enhance joint function [5,12].The effectiveness of these conservative approaches in our patient reaffirms the inflammatory basis of HADD, and supports the diagnosis.

In more severe cases of HADD, interventional treatment approaches can be utilised. Extracorporeal shock wave therapy (ESWT) is a novel approach to HADD, wherein a probe emitting high-frequency sound waves is placed adjacent to CHA deposits [5]. However, a previous study of 54 patients demonstrated that ESWT was inferior to ultrasound-guided corticosteroid injection for HADD of the shoulder [13]. This further supports the decision to utilise corticosteroid injection in our patient's case, and correlates well with the significant improvement in symptoms noted at her ongoing review.

Surgical removal of calcific deposits is reserved for severe cases where conservative and interventional treatments have failed [5]. This tiered approach to treatment allows for tailored management of HADD, ensuring patients receive the most appropriate and effective therapy based on their specific clinical scenario.

CONCLUSION

This case report sheds light on the complexities of diagnosing and managing HADD, particularly in non-typical locations like the gluteus medius tendon. Through a detailed examination of this case and a review of the literature, it emphasises the need for awareness and consideration of HADD in differential diagnoses of hip pain, advocating for a strategic approach to treatment that can significantly improve patient outcomes.

TEACHING POINT

Hydroxyapatite deposition disorder (HADD) is a rare, but important condition to consider for musculoskeletal presentations, particularly in middle-aged females. HADD is best identified with computed tomography (CT), which demonstrates characteristic hazy calcifications near affected joints. CT is a particularly effective diagnostic tool for differentiating HADD from other potential musculoskeletal presentations, particularly in atypical locations, such as the hip.

QUESTIONS

1) Which of the following is true of hydroxyapatite deposition disorder (HADD)?

a) Calcium hydroxyapatite is the commonest form of calcium observed in pathological calcifications throughout the body (applies)

b) HADD has a male predominance

c) HADD has associations with HLA-B2 genotypes

d) HADD was first described in 1970

e) HADD's X-ray findings are predominantly of well-organised, joint-adjacent calcific deposits.

Explanation:

a) Calcium hydroxyapatite is the commonest form of calcium observed within pathological calcifications of the body. [CHA is the commonest form of calcium in human bone, and the commonest precipitant in pathological calcification throughout the body]

b) HADD has a female predominance. [HADD has a significant female predominance, most commonly occurring between the fourth and sixth decades of life]

c) HADD is associated with HLA. [Furthermore, HLA-A1 genotypes appear to have an association with the development of HADD.]

d) HADD was first described in 1907 by Painter. [The underlying aetiology of HADD remains uncertain, despite the literature presenting several cases since its first description by Painter in 1907]

e) HADD's X-ray findings are predominantly of poorly-organised, joint-adjacent calcific deposits. [In particular, owing to the radiopaque nature of CHA, plain radiographs often demonstrate poorly defined densities within soft tissues, adjacent to joints].

2) Which of the following is not a common differential for hydroxyapatite deposition disorder (HADD) in the context of acute joint pain?

a) Trauma
b) Septic arthritis
c) Osteoarthritis (applies)
d) Gout
e) Rheumatoid arthritis

Explanation:

a) Trauma is a common differential diagnosis for acute joint pain caused by HADD. [For instance, without specific imaging, HADD could be mistakenly attributed to trauma-induced joint pain, particularly if the patient's medical history suggests recent injury]

b) Septic arthritis is a common differential diagnosis for HADD. [Moreover, HADD is just one of many potential diagnoses for acute joint pain, which also includes septic arthritis, chronic joint infections, pseudo-hyperparathyroidism, hyperparathyroidism, calcium pyrophosphate deposition disease (CPPD)/chondrocalcinosis, and gout]

c) Osteoarthritis is not a common differential diagnosis for acute joint pain caused by HADD. [For instance, without specific imaging, HADD could be mistakenly attributed to trauma-induced joint pain, particularly if the patient's medical history suggests recent injury]

d) Gout is a common differential diagnosis for acute joint pain caused by HADD. [Moreover, HADD is just one of many potential diagnoses for acute joint pain, which also includes septic arthritis, chronic joint infections, pseudo-hyperparathyroidism, hyperparathyroidism, calcium pyrophosphate deposition disease (CPPD)/chondrocalcinosis, and gout]

e) Rheumatoid arthritis is a common differential diagnosis for acute joint pain caused by HADD. [Moreover, HADD is just one of many potential diagnoses for acute joint pain, which also includes septic arthritis, chronic joint infections, pseudo-hyperparathyroidism, hyperparathyroidism, calcium pyrophosphate deposition disease (CPPD)/chondrocalcinosis, and gout]

3) Which of the following is not commonly a part of the management approach for hydroxyapatite deposition disorder (HADD)?

a) Non-steroidal anti-inflammatory drugs (NSAIDs)
b) Rest and physiotherapy
c) Extracorporeal shockwave therapy (ESWT)
d) Ultrasound-guided corticosteroid injection
e) Oral prednisolone (applies)

Explanation:

a) NSAIDs are often one of the first treatments utilised in the management of HADD. [Initial treatment often starts with NSAIDs to leverage their anti-inflammatory effects, complemented by rest and targeted physiotherapy to enhance joint function.]

b) Rest and physiotherapy are often one of the first treatments utilised in the management of HADD. [Initial treatment often starts with NSAIDs to leverage their anti-inflammatory effects, complemented by rest and targeted physiotherapy to enhance joint function.]

c) Extracorporeal shockwave therapy (ESWT) is a less commonly utilised invasive treatment for managing HADD. [Extracorporeal shock wave therapy (ESWT) is a novel approach to HADD, wherein a probe emitting high-frequency sound waves is placed adjacent to CHA deposits]

d) Ultrasound-guided corticosteroid injection is a commonly utilised invasive treatment for managing HADD [However, a previous study of 54 patients demonstrated that ESWT was inferior to ultrasound-guided corticosteroid injection for HADD of the shoulder]

e) Oral prednisolone is not commonly utilised in the management of HADD, due to the superior efficacy of ultrasound-guided corticosteroid injections into affected areas. [However, a previous study of 54 patients demonstrated that ESWT was inferior to ultrasound-guided corticosteroid injection for HADD of the shoulder]

4) Which of the following may be seen in the investigation findings of hydroxyapatite deposition disorder (HADD) in its chronic/asymptomatic phase?

a) Plain radiographs demonstrate poorly-defined peri-articular calcifications
b) Plain radiographs may demonstrate sclerotic areas of bone around peri-articular calcifications
c) Computed tomography demonstrates poorly-defined peri-articular calcifications with associated soft-tissue oedema
d) Magnetic resonance imaging demonstrates soft-tissue involvement with peri-calcific deposit inflammation, and/or low- to intermediate-T1 and fluid-sensitive signals
e) Mild leukocytosis with slightly elevated inflammatory markers. (applies)

Explanation:

a) Poorly defined peri-articular calcifications are demonstrated on plain radiographs of HADD in the acute, symptomatic phase [Table 1 – Imaging findings]

b) Bony erosion and cortical degeneration may be demonstrated on plain radiographs of HADD in advanced cases [Advanced cases of HADD can also demonstrate bony erosions and cortical degeneration [3].]

c) Poorly defined peri-articular calcifications are demonstrated on computed tomographs of HADD in the acute, symptomatic phase [Table 1- Imaging findings]

d) Soft-tissue involvement with peri-calcific deposit inflammation with or without low- to intermediate-T1 and fluid sensitive signals are observed on magnetic resonance imaging of HADD in the acute, symptomatic phase [Table 1 – Imaging findings]

e) Mild leukocytosis and slightly elevated inflammatory markers are observed in HADD. [Table 1 – Laboratory findings]

5) Which of the following pathophysiological mechanisms has not been proposed as being involved in the development of hydroxyapatite deposition disorder (HADD)?

a) Degenerative calcification resulting from repeated trauma and resultant vascular ischaemia
b) Chondrocyte-mediated calcium deposition
c) Elevated serum calcium levels (applies)
d) A process analogous to endochondral ossification
e) Erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts

Explanation:

a) Degenerative calcification resulting from repeated trauma and resultant vascular ischaemia has been proposed as a potential pathophysiological mechanism for HADD's development. [Four disparate theories have been proposed to contribute to HADD's development: 1) degenerative calcification resulting from repeated trauma and vascular ischaemia; 2) chondrocyte-mediated calcium deposition; 3) an analogous process to endochondral ossification, or; 4) erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts.]

b) Chondrocyte-mediated calcium deposition has been proposed as a potential pathophysiological mechanism for HADD's development. [Four disparate theories have been proposed to contribute to HADD's development: 1) degenerative calcification resulting from repeated trauma and vascular ischaemia; 2) chondrocyte-mediated calcium deposition; 3) an analogous process to endochondral ossification, or; 4) erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts.]

c) Elevated serum calcium levels have not been proposed as a potential pathophysiological mechanism for HADD's development. [Four disparate theories have been proposed to contribute to HADD's development: 1) degenerative calcification resulting from repeated trauma and vascular ischaemia; 2) chondrocyte-mediated calcium deposition; 3) an analogous process to endochondral ossification, or; 4) erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts.]

d) A process analogous to endochondral ossification has been proposed as a potential pathophysiological mechanism for HADD's development [Four disparate theories have been proposed to contribute to HADD's development: 1) degenerative calcification resulting from repeated trauma and vascular ischaemia; 2) chondrocyte-mediated calcium deposition; 3) an analogous process to endochondral ossification, or; 4) erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts.]

e) Erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts has been proposed as a potential pathophysiological mechanism for HADD's development. [Four disparate theories have been proposed to contribute to HADD's development: 1) degenerative calcification resulting from repeated trauma and vascular ischaemia; 2) chondrocyte-mediated calcium deposition; 3) an analogous process to endochondral ossification, or; 4) erroneous tendon-derived stem cell differentiation into chondrocytes or osteoblasts.]

REFERENCES

[1] Hongsmatip P, Cheng KY, Kim C, Lawrence DA, Rivera R, Smitaman E. Calcium hydroxyapatite deposition disease: Imaging features and presentations mimicking other pathologies. *Eur J Radiol*. 2019; 120:108653. PMID: 31550638.

[2] Garcia GM, McCord GC, Kumar R. Hydroxyapatite crystal deposition disease. *Semin Musculoskelet Radiol.* 2003; 7(3): 187-193. PMID: 14593560.

[3] Dieppe PA, Crocker PR, Huskisson EC, Willoughby DA. Apatite deposition disease: a new arthropathy. *Lancet.* 1976; 1(7954): 266-269. PMID: 55584.

[4] Bishop WA. Calcification of the supraspinatus tendon: cause, pathologic picture and relation to the scalenus anticus syndrome. *Archives of Surgery.* 1939; 39(2): 231-246.

[5] Hegazi T. Hydroxyapatite Deposition Disease: A Comprehensive Review of Pathogenesis, Radiological Findings, and Treatment Strategies. *Diagnostics (Basel).* 2023; 13(16): 2678. PMID: 37627938.

[6] Mavrikakis ME, Drimis S, Kontoyannis DA, Rasidakis A, Moulopoulou ES, Kontoyannis S. Calcific shoulder periarthritis (tendinitis) in adult onset diabetes mellitus: a controlled study. *Ann Rheum Dis.* 1989; 48(3): 211-214. PMID: 2930276.

[7] Harvie P, Pollard TC, Carr AJ. Calcific tendinitis: natural history and association with endocrine disorders. *J Shoulder Elbow Surg.* 2007; 16(2): 169-173. PMID: 17188907.

[8] Hayes CW, Conway WF. Calcium hydroxyapatite deposition disease. *Radiographics.* 1990; 10(6): 1031-1048. PMID: 2175444.

[9] Siegal DS, Wu JS, Newman JS, Del Cura JL, Hochman MG. Calcific tendinitis: a pictorial review. *Can Assoc Radiol J.* 2009; 60(5): 263-272. PMID: 19931132.

[10] Rejnierse M, Schwabl C, Klauser A. Imaging of crystal disorders: calcium pyrophosphate dihydrate crystal deposition disease, calcium hydroxyapatite crystal deposition disease and gout pathophysiology, imaging and diagnosis. *Radiol Clin North Am*. 2022; 60(4): 641-656. PMID: 35672096.

[11] Kraemer EJ, El-Khoury GY. Atypical calcific tendinitis with cortical erosions. *Skeletal Radiol.* 2000; 29(12): 690-696. PMID: 11271549.

[12] Beckmann NM. Calcium apatite deposition disease: diagnosis and treatment. *Radiol Res Pract*. 2016: 4801474.

[13] Kim YS, Lee HJ, Kim YV, Kong CG. Which method is more effective in treatment of calcific tendinitis in the shoulder? Prospective randomized comparison between ultrasound-guided needling and extracorporeal shock wave therapy. *J Shoulder Elbow Surg.* 2014; 23(11): 1640-1646. PMID: 25219475.

FIGURES

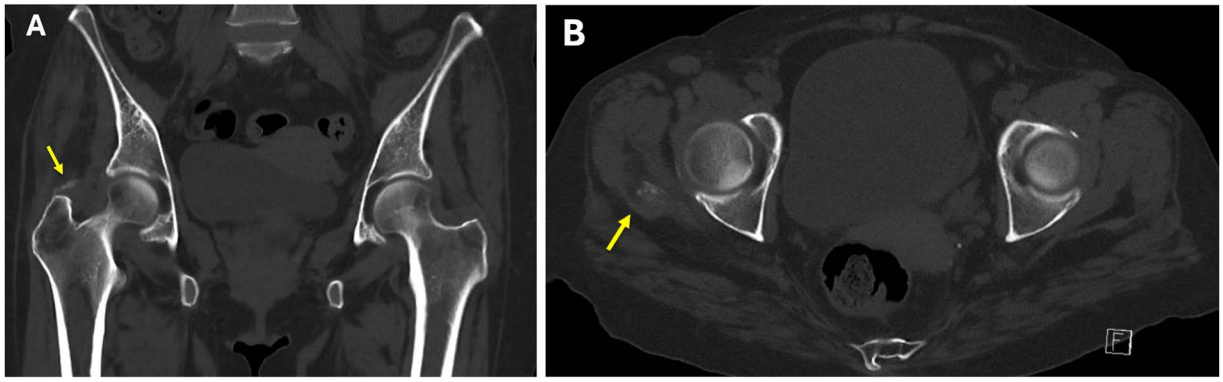

Figure 1: A 52-year old female with hydroxyapatite deposition disorder. FINDINGS: A small area of poorly defined calcification at site of right gluteus medius insertion into right greater trochanter (arrows). TECHNIQUE: A Non-contrast computed tomography coronal (a) and axial (b) images of the pelvis

Table 1: Diagnostic pathway for HADD

Clinical Presentation	Acute joint pain, stiffness, or swelling with localized tenderness and restricted joint movement; erythema (11, 1) Most commonly affects the shoulder and hip (11), however can also affect the elbow, wrist, hand, spine, ankle and foot.
Imaging Findings	**Acute phase** - Plain radiographs – poorly-defined peri-articular calcifications (12) - CT – poorly-defined peri-articular calcifications, associated soft-tissue oedema surrounding calcifications (12) - MRI - may include soft tissue involvement and peri-calcific deposit inflammation; low/intermediate T1 and fluid-sensitive signals (12) **Asymptomatic/chronic phase** - Plain radiographs – well-defined, homogenous peri-articular calcifications (6, 12) - CT - well-defined, homogenous calcifications without associated soft-tissue oedema (6, 12) - MRI - homogenous signal voids on all sequences (6)
Laboratory Tests	Often non-specific findings (if any) – mild leukocytosis, mildly elevated inflammatory markers (6) Often more useful to rule out other conditions (e.g., infections, metabolic disorders) (1, 6)
Differential Diagnosis	Exclude other causes of joint pain such as trauma, septic arthritis, CPPD, gout, and rheumatoid arthritis Presence of poorly defined calcifications on imaging aids significantly in differentiation from other causes
Clinical Judgment	Integration of clinical presentation, imaging findings, and exclusion of other conditions to confirm HADD diagnosis

KEYWORDS

Hydroxyapatite deposition disorder, Gluteal calcific tendonitis, Calcific tendinosis, Calcium hydroxyapatite, Hip pain,Diagnosticimaging.