Evaluation of Complex Regional Pain Syndrome In the Lower Extremity with Magnetic Resonance Imaging

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STATEMENT OF PURPOSE

It is uncommon for patients with Complex Regional Pain Syndrome (CRPS) to receive serial MRI scans. This study utilizes a unique cohort of CRPS patients receiving multiple MRI scans to identify specific characteristics and progressive MRI changes within a 12-month period.

Additionally, our research helps differentiate CRPS related MRI findings from pathologies with similar characteristics such as overuse syndrome, subchondral insufficiency fractures, and osteomyelitis.

LITERATURE REVIEW

Complex regional pain syndrome (CRPS), Sudek atrophy, and causalgia is a serious and critical lifelong disease with a wide variety of clinical manifestations if not diagnosed and treated. The pathophysiology is still not well understood which leads to difficulty in diagnosis and treatment [1,2,3].

CRPS is a complication that may arise after any type of trauma or operation, especially minor trauma. It commonly leads to critical symptoms such as pain, edema, autonomic dysfunction, movement disorder, and trophic changes [3,4].

CRPS is divided into two groups: Type I and Type II. Type I is also known as RSD and CRPS Type II is also known as causalgia [4]. CRPS Type I is one of the more challenging pathologies to diagnose after trauma, especially in the early stages due to similar clinical presentation and MRI findings between CRPS and other pathologies [3,5,6].

Features of CRPS on imaging have been described as intermediate T1 marrow signal alteration and hyperintensity on fluid sensitive sequences, such as T2, STIR, SPIR, and proton density fat saturation [1,8]. These imaging characteristics often overlap with those of altered biomechanics of weight bearing and disuse. Extraosseous manifestations are variable and include soft-tissue edema, skin thickening and muscle atrophy [7]. Unlike other pathologies, there has been limited evidence characterizing progression of CRPS via imaging.

CASE STUDY

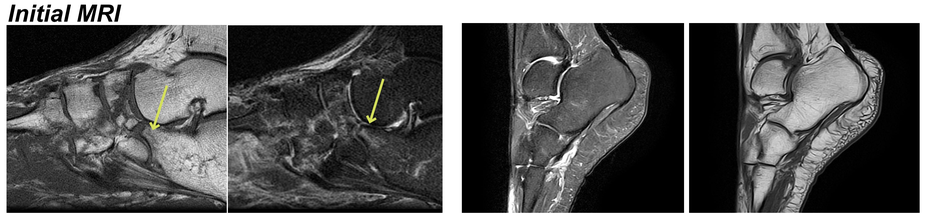
CRPS was confirmed in four cases with serial MRIs and supported clinical symptoms reported. MRIs were obtained and evaluated every 3-6 months to identify specific and significant radiographic changes with disease progression. Other pathologies were also collected from confirmed cases from the same imaging system.

Patient data and imaging were collected through the PACS system InteleViewer from Proscan Imaging Center to identify patients, diagnoses, and imaging.

CASE STUDY

PROGRESSION OF CRPS ON MRI

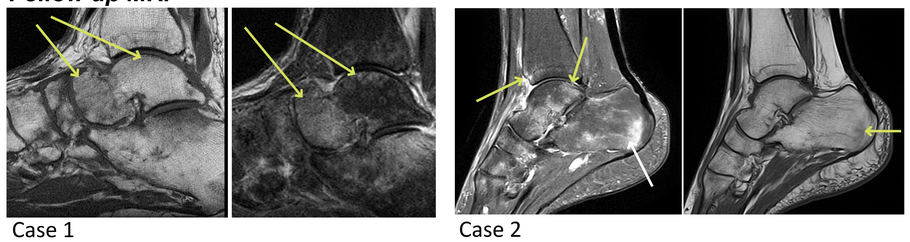
Initial MRI



Case 1 Case 2

Initial MRI taken one week to three months post injury showed a consistent pattern of minimal to no scattered patchy marrow edema on STIR with minimal signal alterations on T1.

Follow up MRI

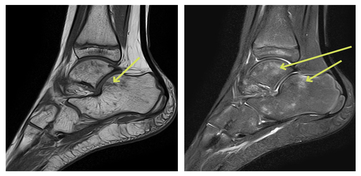


Case 1 Case 2

MRI taken average five to six months post injury starts to show subtle changes on T1 images. T2 images reveal interval development of extensive patchy subcortical, peripheral and medullary cavity edema.

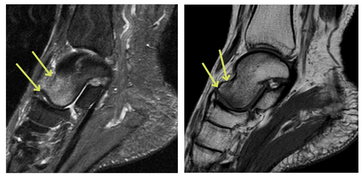
Differential Diagnosis on MRI

Overuse Syndrome



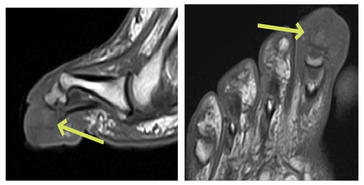
In overuse syndrome, there are invariably patchy foci with scattered signal within the medullary cavity with high bone turnover on both T1 and T2 images. CRPS tends to demonstrate peripheral, subcortical distribution of bone marrow edema.

Subchondral Insufficiency Fracture (SIF)



SIF can be differentiated from CRPS in terms of location and morphology of marrow edema. SIF is subchondral and subarticular, which can be differentiated from subcortical, non-articular peripheral marrow edema. Unlike SIF, which is usually unifocal, CRPS is multifocal. In addition, the discrete subcortical lines of SIF are often absent in CRPS.

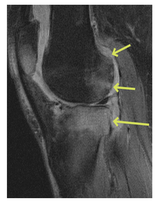
Osteomyelitis



In osteomyelitis, a cardinal feature is vanishing signal or erosion of bone marrow on T1 weighted imaging and also involves both medullary cavity and subcortical bone and may involve adjacent bones. Signal alteration in CRPS on T1 MRI is scant often seen late and inconsistent. The pattern of marrow edema is also patchy and involve multiple bones in a non-contiguous fashion.

CASE STUDY

Rheumatoid Arthritis (RA)



CRPS can be differentiated from RA due to concurrent synovial hypertrophy, presence of joint effusions and the distribution of bone marrow edema in the periarticular distribution. Erosive bony changes is another characteristic specific of early RA but not CRPS [10].

ANALYSIS & DISCUSSION

In our case series, initial inciting injury is often minimal or subclinical with the most common injury being ankle inversions. The MRI progressions in our cases demonstrate bone marrow signal may show absent to minimal changes up to an average of three months post injury. Earliest signs include subtle subcortical edema mainly on T2 weighted images. More definite multifocal subcortical edema peaked at 5-6 months with near complete resolution of bone marrow edema after 13-months.

One study reported reduction in extent of marrow edema on MRI during remission phase which paralleled clinical improvement [12]. In our series, the more delayed the clinical time course, the more likely the T1 signal is abnormal, and the more conspicuous the subcortical T2 signal hyperintensity. The presence or absence of T1 signal alteration is also not a reliable indicator of CRPS. The most specific features that help differentiate CRPS on MRI include peripheral, subcortical, non-articular, non-weight-bearing marrow edema.

MRI has proven to be a reliable technique identifying CRPS than other imaging techniques [8]. This case series revealed a specific pattern of marrow edema observed 2-3 months after the initial injury. Therefore, follow-up MRI should be considered even if the initial MRI is unremarkable. It is important to consider CRPS as a possible diagnosis if there is no improvement with conservative treatment and there is continued pain out of proportion. Our study illustrates the development of marrow edema on MRI can also aid in CRPS diagnosis and its progression.

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