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Early changes in micro-architectural bone parameters in the development of CRPS after a distal radius fracture

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Background

- Complex regional pain syndrome (CRPS) is a debilitating clinical syndrome characterized by pain that is disproportionate to the inciting event (e.g. a distal radius fracture), decreased function, and bone and muscle loss.
- Etiology is currently unknown, hypotheses include neurological, vasomotor and immune dysfunctions.
- The timely diagnosis is challenging and subject to debate.[1]

Introduction

High-resolution peripheral quantitative computed tomography (HR-pQCT) is an imaging modality with a resolution of 82µm. This enables the assessment of bone microarchitecture *in vivo*. In addition, finite elements analysis (FEA) can be applied to these images to perform strength estimation of the bone.[2]

Recently, these techniques have been applied in the longitudinal follow-up of patients with a distal radius fracture to assess changes in bone microarchitecture and bone strength during fracture healing.[3]

A 54-year old patient in this study was diagnosed with persistent CRPS after the fracture. The HR-pQCT-scans performed during the 2 years post-fracture show new insights in de development bone loss in CRPS.

Methods

- 18 postmenopausal women with a distal radius fracture treated by cast immobilization were included within 2 weeks post-fracture, 15 completed the 2-year follow up. One patient was diagnosed with persistent CRPS.
- HR-pQCT scans were performed at 12, 23, 45 and 86 days and 26 months post-fracture.
- Bone density and microarchitecture were analyzed, in addition to estimation of compression stiffness by FEA.

Results

HR-pQCT Images

Two-year follow up HR-pQCT scans showed trabecular resorption proximal, but not distal to the fracture line. The contralateral side showed a normal trabecular structure.

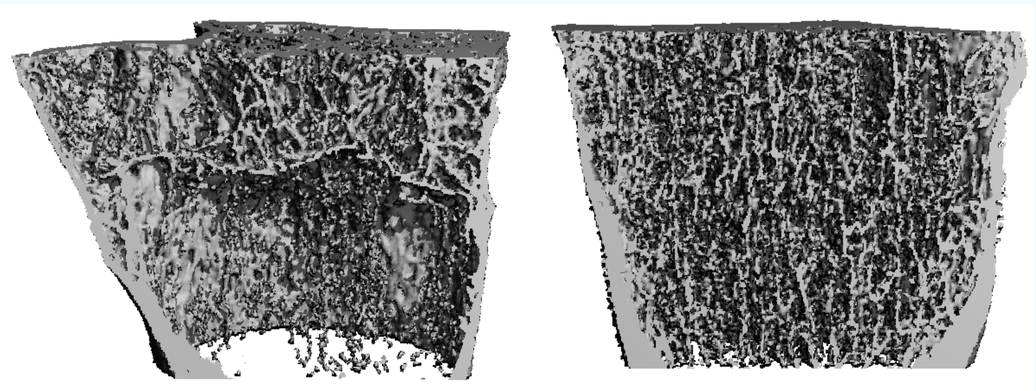

Figure 1: 3D reconstructions of 2-year follow up HR-pQCT scans of fractured CRPS radius (left) and contralateral radius (right).

Density & Microarchitecture

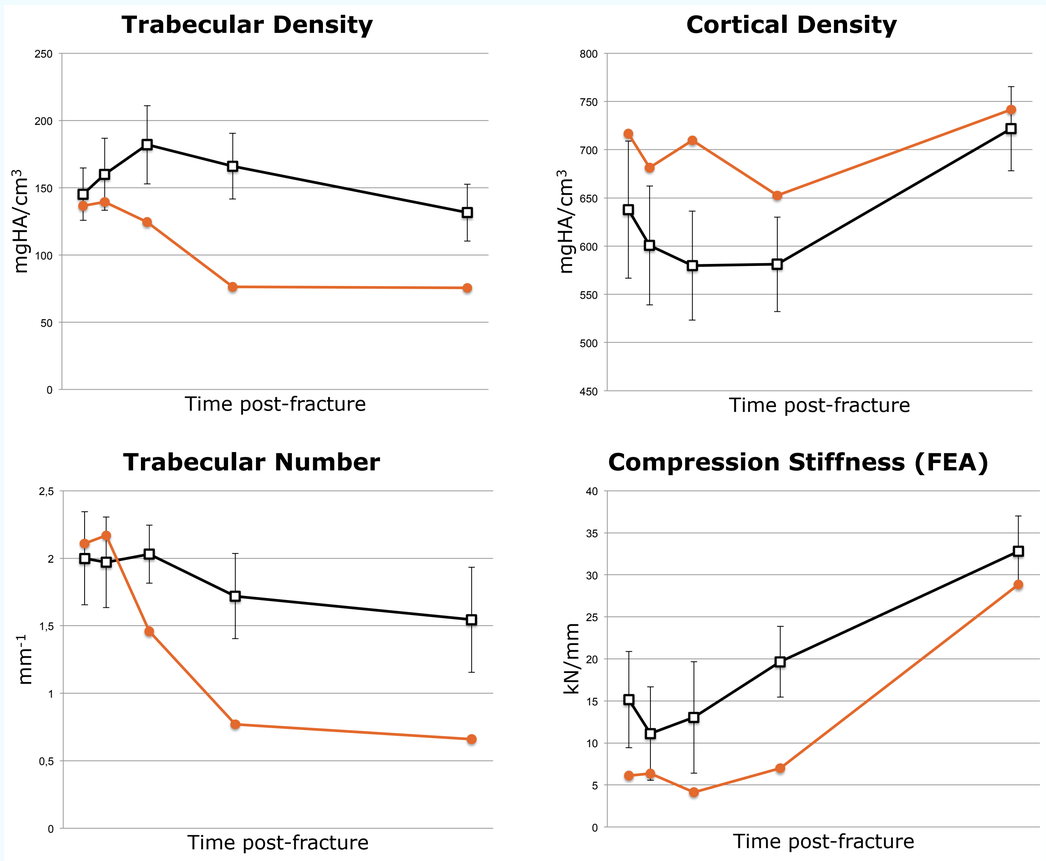

Figure 2: Trabecular Density and trabecular number show a marked and early decrease in the development of CRPS, compared to normal healing. Cortical density is unaffected resulting in a restored stiffness as estimated with FEA. (Black=group, median with interquartile range; Orange=CRPS-case)

Vasculature

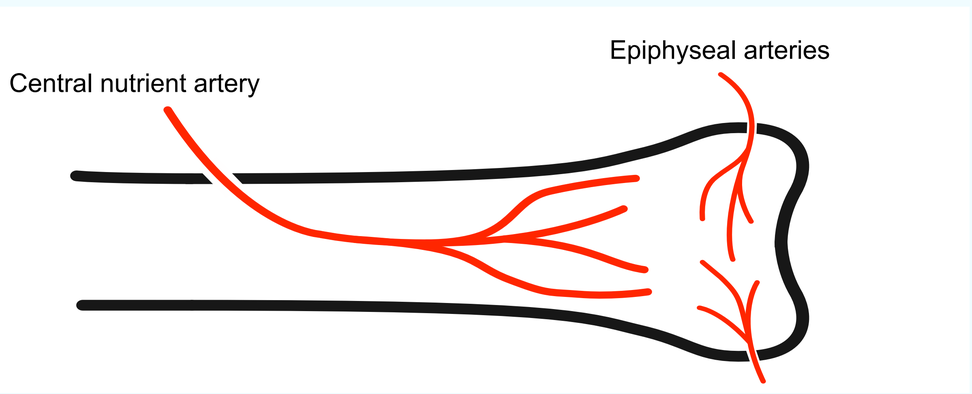

Figure 3: The diaphysis is supplied by a central nutrient artery, whereas the epiphysis receives blood via distal arteries.

Conclusions

- Trabecular density and number showed distinct and early changes in the development of CRPS in this single distal radius fracture patient.
- This illustrates the possible role of HR-pQCT in the early identification of CRPS-related bone loss.
- The anatomical localization of trabecular bone changes in the diaphysis and proximal to the fracture location suggests involvement of the central nutrient artery in the resorption process.

References

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