

# The clinical utility of SMI for assessing musculoskeletal inflammation: case study reports

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### Introduction

Ultrasound technology to visualise the microvasculature continues to improve where power and colour Doppler ultrasound remains a quick and non-invasive method of assessing the vascularity of tumours and tissue. The advent of contrast enhanced ultrasound (CEUS) imaging using microbubbles improved the sensitivity and resolution of the microvessels which can be imaged but requires an intravenous administration of contrast agents.

The latest development by Toshiba Medical Systems, Superb Microvascular Imaging (SMI), allows imaging of the microvasculature without the need

for contrast enhancement employing an advanced Doppler algorithm with a new level of sensitivity and frame rate. The sensitivity and finer detail of the microvessels which can be visualised with SMI appears significantly better when compared with conventional power Doppler, and rivals that depicted with contrast enhancement.

The following three case studies illustrate the potential clinical value of this advanced Doppler technology and how it could significantly change clinical management.

### Case 1

This case is in a gentleman who complained of pain overlying the medial aspect of his left patella

tendon near its tibial insertion. Figure 1a shows a normal grey-scale appearance with some subtle, mildly reduced echogenicity but no significant thickening or tear is evident. When SMI is used, there is clear hypervascularity within the tendon attachment itself (Figure 1b) and the fine microvasculature detail of this segment of inflamed tendon is clearly outlined in Figure 1c. Power Doppler images did not reveal any significant vascularity with a mostly noisy power background signal (Figure 1d). The SMI finding corresponded to the site of exact tenderness confirming a tendinitis and therefore this led to appropriate treatment with a steroid injection for symptom alleviation.



Fig. 1a: The medial aspect of the tibial attachment of this left patella tendon appears unremarkable on this grey-scale image at site of tenderness.

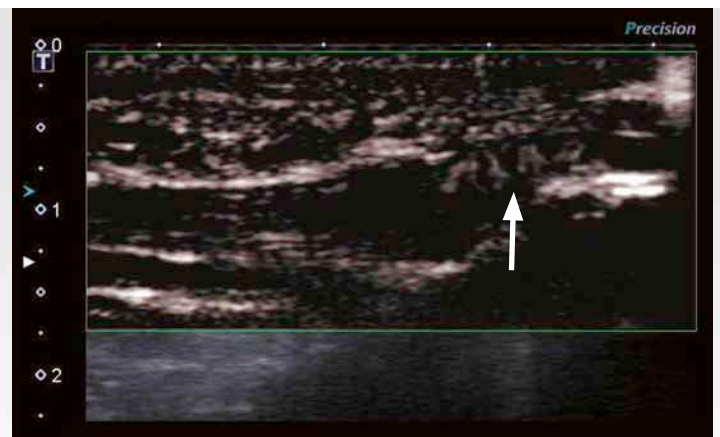


Fig. 1b: The fine microvasculature detail of this inflamed tendon attachment is clearly illustrated on this SMI mode single view image (arrow).

**Case 2**

The following are images of a patient with a history of psoriatic arthropathy who complained of tenderness in the left mid-foot region. The grey-scale ultrasound image (Figure 2a) demonstrates a mildly thickened synovium with no erosions, of the left naviculo-cuneiform joint.

Figure 2b shows significant vascularity with power Doppler consistent with an active synovitis. When SMI is applied, the branching pattern of the microvasculature can be readily appreciated (Figure 2c).

**Case 3**

This example is of a patient with known rheumatoid arthritis who complained of pain in the right sternoclavicular joint. In Figure 3a, there is a modestly thickened synovium but no definite erosion is evident. Figure 3b shows that there is no significant vascularity with power Doppler. There is only minimal

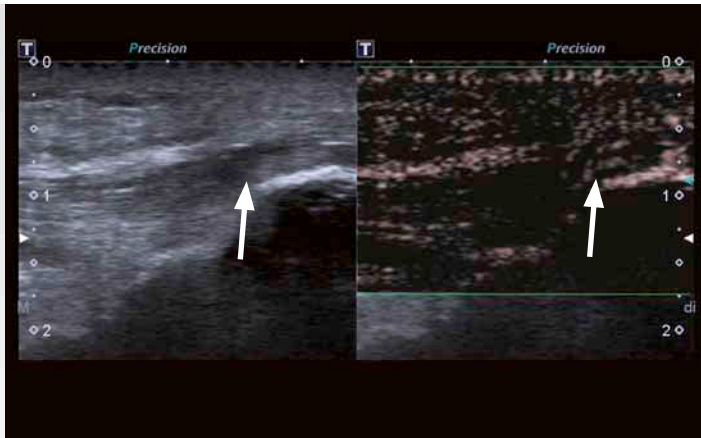


Fig. 1c: The marked vascularity of the tendon attachment can be detected with SMI (arrow) corresponding to the site of tenderness and compatible with a tendinitis.

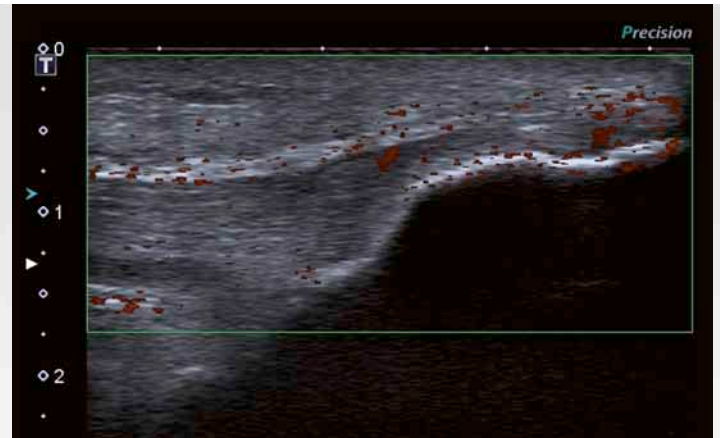


Fig. 1d: There is no significant vascularity with power Doppler, where the gain has been increased to just above noise.

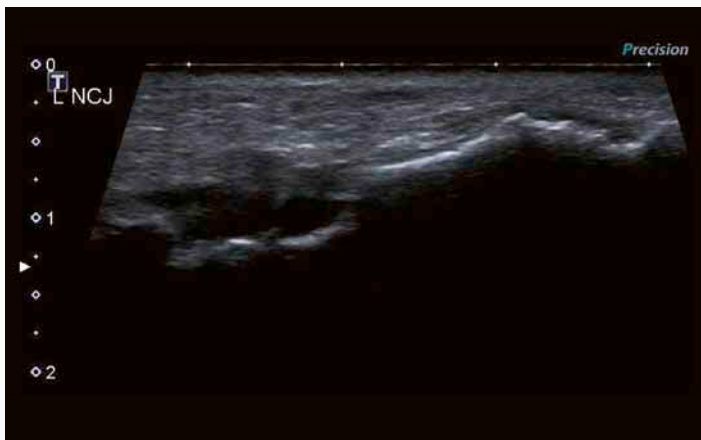


Fig. 2a: Grey-scale image of the left naviculo-cuneiform joint in a patient with psoriatic arthritis and pain.

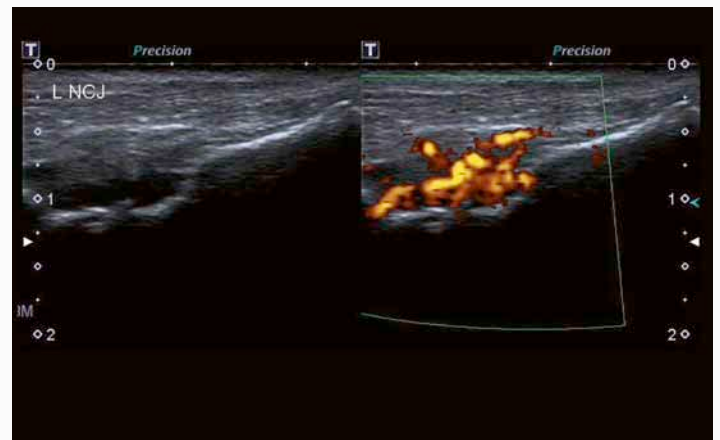


Fig. 2b: The thickened synovium of the left naviculo-cuneiform joint is markedly vascular.

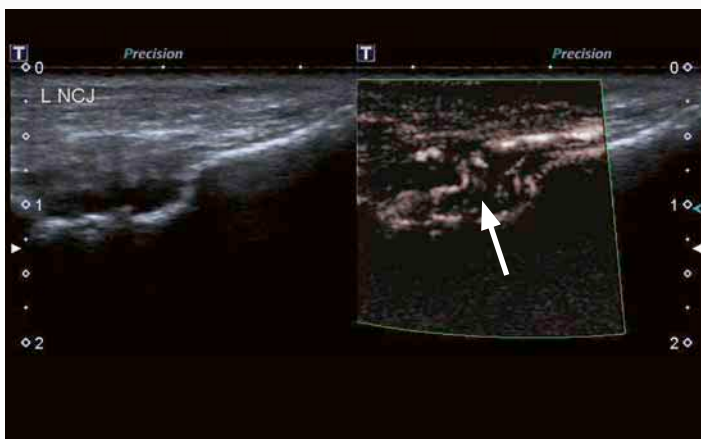


Fig. 2c: With Superb Microvascular Imaging (SMI), the detailed branching pattern of the microvasculature is better defined.

vascularity seen in the periphery of the joint just above the noise level. With SMI, the branching pattern of the microvasculature within the inflamed joint itself can be clearly detected and is illustrated in Figure 3c. This convincingly confirmed the presence of an active synovitis and the patient subsequently had a steroid injection which alleviated her symptoms.

**Conclusion**

Our early experience with SMI shows that it has excellent depiction and fine detail of the microvasculature not seen with routine Doppler technology. With significantly increased sensitivity, SMI has great potential at identifying low-grade inflammation which was not possible previously. The improved

diagnostic confidence with this technology would have a significant clinical impact and influence clinical management of patients.



Fig. 3a: The right sternoclavicular joint of a patient with rheumatoid arthritis demonstrates a thickened synovium on this grey-scale image.

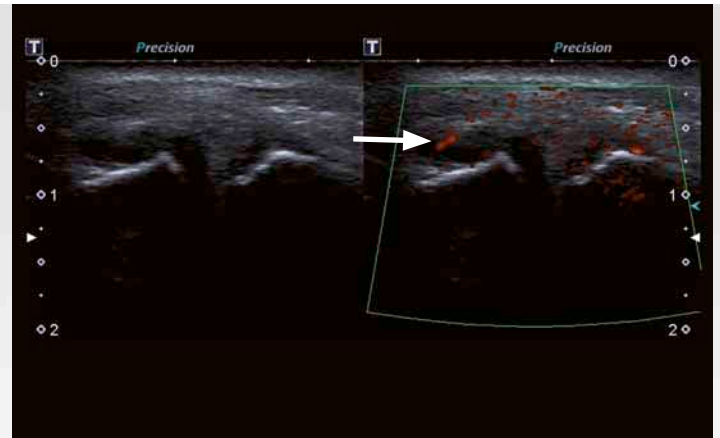


Fig. 3b: There is only minimal peripheral vascularity with power Doppler (thick arrow).



Fig. 3c: However, with the use of SMI, vascularity within the synovium (thin arrow) can be detected confirming an active synovitis.

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