

Low Dose MR Angiography of the Pedal Vessels at 3 Tesla

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Purpose

Evaluating vascular anatomy of the foot is an essential part of surgical planning to determine bypass graft target vessels in patients with limb threatening ischemia (1). Effective demonstration of the pedal arteries with magnetic resonance angiography (MRA), is challenging as part of the routine three-stage MRA 'runoff' evaluation of the lower extremities. The competing parameters of anatomic coverage, venous contamination, and spatial resolution sacrifice the detail needed for the pedal vessels (2).

As one approach to this challenge we evaluated MRA at 3T for imaging the deep plantar arch using low dose IV gadolinium contrast. Dedicated TRICKS (time resolved imaging of contrast kinetics) MRA (3) of the foot was performed in order to achieve adequate anatomic coverage, and spatial and temporal resolution. Low dose MRA was evaluated with the goal of incorporating MRA of the foot into a comprehensive MRA of the lower extremities.

Methods

Dedicated TRICKS MRA (29 phases, 6min 43 sec, temporal resolution 14 sec, bandwidth ± 12.5 kHz, slice thickness 2.2mm) of the feet were acquired on 10 normal volunteers (age 20-35) with no known peripheral vascular disease using a GE 3T system (Waukesha, WI), following an IRB approved protocol. The software reconstructs 7-9 of these phases depending on spatial resolution. Using a head coil, a total of three MRAs were performed on each volunteer, including dedicated sagittal acquisitions of each foot (24 cm FOV, matrix 320 x 224) and a third oblique acquisition of both feet simultaneously (28 cm FOV, matrix 320 x 224) in a plane parallel to the plantar fascia. Each injection utilized a half weight-based dose (0.05 mmol/kg) of IV Gd-DTPA (Magnevist, Berlex, Wayne, NJ). Maximum intensity projection images of the TRICKS MRA data were evaluated on an Advantage windows workstation (GE, Waukesha, WI) for depiction of vascular detail, image graininess, and venous contamination.

Results

The deep plantar arch was visualized in 9 of the 10 volunteers. Plantar metatarsal arteries were well visualized in most cases.

Both the dedicated sagittal MRAs of each foot, and the coronal MRA of both feet depicted arterial anatomy of the feet with several phases free of venous contamination. Spatial resolution and SNR were better on the dedicated sagittal acquisitions, but diagnostically adequate on the single coronal acquisition.



Figure 1: Example MIP images from a dedicated sagittal plane pedal TRICKS MRA at 3T using half dose IV Gd-DTPA, demonstrating venous contamination free windows and depiction of the plantar arteries in this patient with a mid-foot arteriovenous malformation.

Conclusions

This evaluation has demonstrated the feasibility of using low dose TRICKS MRA at 3T to provide venous free images of the pedal vessels with high spatial resolution in normal subjects. Further evaluation of this method on patients with peripheral vascular disease is required. If successful this approach can provide a comprehensive MRA examination of the lower extremities for distal bypass graft planning.

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2. Wang Y, et al. *Invest Radiol* 2001;36(3):170-177.
3. Swan JS, et al. *Radiology* 2002;225(1):43-52.