# 125 µm³ spatial resolution steady state MRA of the upper legs with a blood pool contrast agent using the quadrature body coil at 1.5T

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## Aim of the study:

To set up and evaluate a high spatial resolution (125 µm³) large field of view contrast enhanced MR angiography (3D CEMRA) sequence of the upper legs after application of a blood pool contrast agent using only the quadrature body coil in patients referred for peripheral arterial occlusive disease (PAOD).

## Introduction:

3D CEMRA of peripheral vessels is routinely used in the diagnostic work-up of patients with peripheral arterial occlusive disease (PAOD)[1]. Blood pool contrast agents provide a prolonged time frame with high vessel-to-background contrast (steady state). This enables an extension of the imaging time of 3D CEMRA and an increase in the spatial resolution of 3D CEMRA[2-3]. Steady state imaging of the peripheral vasculature of the lower extremities has been shown to allow for high sensitivity and specificity of stenosis grading in PAOD[4]. The current study was carried out to evaluate whether the signal at 1.5T is sufficient for diagnostic image quality of 125 µm³ high spatial resolution 3D CEMRA acquired using a blood pool agent with the quadrature body coil only.

## Methods:

7 patients (mean age: 69.7 ± 9.4 years ; range, 51-82 years) with known PAOD (Fontaine stages; IIb:2, III:5) were examined with Gadofosveset Trisodium (Vasovist, Bayer Schering Pharma, Berlin, Germany; 0.03 mmol/kg body weight at a flow rate of 1.2 ml/sec.) on a 1.5 Tesla whole body MRI (Achieva, Philips Medical Systems, Best, NL). High spatial resolution steady state 3D CEMRA images were acquired with a non-interpolated voxel size of 0.49 x 0.49 x 0.48 mm³ [= 125 µm³] (TR, TE, FA; 7.4, 2.4, 25°). Without parallel imaging total imaging time was 15:11 min. Cathether angiography (DSA) of the upper legs was available for comparison in all patients serving as the standard of reference. Two readers independently evaluated artefacts, overall image quality of 3D CEMRA, and grade of stenosis as compared to DSA. SNR and CNR levels were measured in the superficial femoral arteries, profound femoral arteries, the femoral veins and the greater saphenous veins using both sequences.

## Results:

Despite the long acquisition time of high spatial resolution steady state 3D CEMRA, it was successfully completed by all patients. Minor movement artefacts were observed in 3/7 patients in steady state 3D CEMRA. Overall image quality was rated excellent in 4/7 patients, good in 2/7 patients, and diagnostic in 1/7 patients (image quality was impaired by movement artefacts due to pain in this case). Stenosis grading in high spatial resolution steady state 3D CEMRA matched with that in DSA in 7/7 patients (fig.1). High SNR and CNR levels were observed in all vessels (tab.1).

## Conclusion:

125 µm³ spatial resolution 3D CEMRA of the thigh with a blood pool contrast agent is feasible using a quadrature body coil exclusively despite of long acquisition times and allowed for high SNR and CNR levels of the visualized vessels.

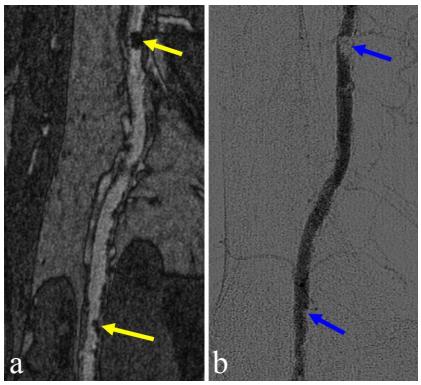


**Fig.1 Multiple stenoses in the distal left superficial femoral artery and popliteal artery (arrows) in steady state high resolution 3D CEMRA (a) and DSA (b)**

| | RIGHT | | | | | | | | LEFT | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A FEM SUP | | A PROF FEM | | V SAPH | | V FEM | | A FEM SUP | | A PROF FEM | | V SAPH | | V FEM | |
| Patient | SNR | CNR | SNR | CNR | SNR | CNR | SNR | CNR | SNR | CNR | SNR | CNR | SNR | CNR | SNR | CNR |
| 1 | 13,7 | 10,2 | 13,2 | 9,7 | 12,4 | 8,9 | 12,9 | 9,4 | 15,3 | 11,1 | 14,3 | 10,2 | 12,5 | 8,4 | 12,5 | 8,4 |
| 2 | 10,6 | 7,0 | 12,6 | 9,0 | 9,3 | 5,7 | 11,0 | 7,4 | 10,8 | 7,3 | 15,1 | 11,6 | 11,2 | 7,7 | 12,6 | 9,1 |
| 3 | 16,3 | 10,5 | 18,9 | 13,1 | 18,9 | 13,1 | 12,8 | 7,1 | 14,0 | 9,3 | 17,5 | 12,8 | 14,2 | 9,5 | 15,0 | 10,3 |
| 4 | 12,6 | 9,2 | 11,3 | 8,0 | 10,9 | 7,6 | 10,9 | 7,6 | 13,4 | 8,4 | 13,7 | 8,8 | 12,4 | 7,4 | 13,0 | 8,1 |
| 5 | 11,5 | 8,5 | 13,3 | 10,3 | 15,1 | 12,1 | 11,9 | 8,8 | 13,7 | 9,5 | 14,8 | 10,6 | 11,9 | 7,8 | 12,4 | 8,2 |
| 6 | 15,0 | 10,9 | 14,7 | 10,6 | 15,8 | 11,7 | 15,9 | 11,8 | 13,4 | 9,7 | 13,2 | 9,4 | 11,6 | 7,8 | 12,9 | 9,1 |
| 7 | 13,3 | 9,5 | 13,9 | 10,1 | 16,4 | 12,6 | 13,2 | 9,4 | 13,5 | 10,1 | 15,0 | 11,5 | 12,2 | 8,8 | 13,4 | 9,9 |
| Mean | 13,3 | 9,4 | 14,0 | 10,1 | 14,1 | 10,2 | 12,7 | 8,8 | 13,4 | 9,3 | 14,8 | 10,7 | 12,3 | 8,2 | 13,1 | 9,0 |
| Std Dev | 2,0 | 1,3 | 2,4 | 1,6 | 3,4 | 2,8 | 1,7 | 1,6 | 1,3 | 1,2 | 1,4 | 1,4 | 0,9 | 0,7 | 0,9 | 0,9 |

**Tab.1 SNR and CNR values in major arterial and venous vessels of the upper leg in steady state high resolution 3D CEMRA with the quadrature body coil (A FEM SUP = superficial femoral artery, A PROF FEM = profound femoral artery, V SAPH = saphenous vein, V FEM = femoral vein)**

**References:**
**1 Lenhart M et al., Rofo 2002; 174:1289-1295.**
**2 Grist TM et al., Radiology 1998; 207:539-544.**
**3 Rapp JH et al., Radiology 2005; 236:71-78.**
**4 Hadizadeh DR et al., Radiology 2008; 249:701-711**