Continuously Acquired Moving Table Peripheral MRA Compared to Conventional Multi-Station Peripheral MRA

F. M. Vogt[1], M. O. Zenge[1], M. E. Ladd[1], K. Brauck[1], S. Massing[1], J. Barkhausen[1], H. H. Quick[1]
[1]Diagnostic and Interventional Radiology, University Hospital, Essen, NRW, Germany

Introduction:

Recently, multi-station protocols have been developed for visualization of spatially extended vascular anatomy as necessary for MRA of the lower extremities. Although these methods have been shown to be accurate (1), table repositioning between successive stations as well as the need for acquiring slightly overlapping FOVs inherently limits the time-efficiency of multi-station techniques. Furthermore, artifacts at the intersection of single FOVs potentially render image interpretation sometimes difficult. "Move during scan" MRI techniques have recently been introduced that potentially can improve data acquisition efficiency and provide the physician with seamless large FOV images of extended vascular anatomy (2). Initial studies have shown the feasibility of such move during scan 3D MRA techniques using the body RF coil for signal reception. Limited image quality associated with body RF coil imaging, however, limits the achievable spatial resolution which is crucial for the assessment of the peripheral arterial system. Purpose of our study was the implementation of a continuously moving table technique for peripheral 3D MRA using dedicated multi-channel surface coils and to compare this technique to a conventional multi-station protocol.

Methods:

Five healthy male volunteers and five patients with clinically documented occlusive arterial disease of peripheral vasculature underwent MRA of the run-off vessels during continuous moving table data acquisition. All imaging was performed on a Siemens Avanto 1.5 T (Siemens, Medical Solutions, Germany) which provides 32 receiver channels and a matrix of dedicated phased-array surface coils. For signal reception a dedicated peripheral vasculature coil, two adjacent body phased-array coils and a spine array coil (connecting to 16 of 32 receiver channels) were used, covering the peripheral vessel system from the renal down to the pedal arteries. All receiving channels were active during the entire data acquisition period. The reconstruction algorithm of Kruger et al (2) for 3D coronal datasets was incorporated into the standard Siemens reconstruction program**.** The continuously acquired 3D data set was collected in the coronal plane during biphasic automated injection of 0.2 mmol/kg GD-BOPTA. Prior to data acquisition, a cuff was placed at the mid-femoral level of the legs to avoid venous overlay and remained inflated to 50 mmHg until the end of the examination (3). A 3D FLASH sequence with TR/TE 2.02 ms/0.89 ms, FOV 400mm x 1398mm, flip 19°, and a slab of 115mm was used. The total acquisition time was 77 s using a table velocity of 15mm/s. The voxel size of the continuous moving table protocol was 1.6x1.3x1.6 mm³.
Conventional four-station 3D peripheral MRA served as standard of reference and was conducted within 3 days. Scanning parameters for the conventional protocol were adapted for each station: 3D FLASH: TR 2.36/2.36/2.42/3.43 ms, TE 0.98/0.96/0.99/1.28 ms, FOV 290-400x400 mm**,** flip 25°. Total acquisition time was 77 sec**.** Image quality was assessed on a segment per segment basis on coronal source images for both protocols by two radiologists in consent using a five point scale (1=uninterpretable to 5= very good).

Results:

Compared to images acquired with the standard peripheral MRA imaging protocol continuously acquired data sets showed excellent correlation in all volunteers and patients.
Assessment of image quality revealed slightly higher values for the conventional protocol compared to those data collected with the continuously moving table technique: 4.2 ± 1.0 vs. 3.5 ± 0.91.
Image interpretation and vessel assessment on MDS images was facilitated due to the lack of discontinuity artifacts. However, due to higher spatial resolution of the two lower station using the standard protocol, small intravascular arterial vessels appeared crisper. The time for data reconstruction was comparable for both protocols (10 min).

Discussion:

The robustness of the continuous moving-table data acquisition technique and image quality achieved in this study compared to conventional 3D MRA protocol justifies further clinical investigation on patients. Further increase of the spatial resolution and an extension of the FOV to whole-body MRA applications potentially can be implemented into the concept of continuously moving table MRA. Therefore a technique for switching only the RF coil elements in the isocenter on and of during table movement has to be investigated.

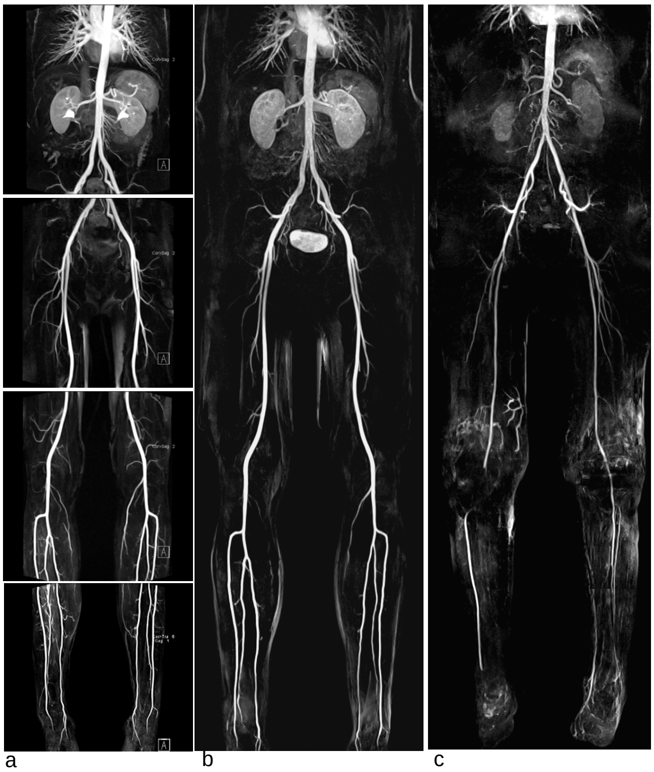
a b c

Fig. 1: Coronal MIPs of a) conventional four station 3D peripheral MRA compared to b) continuously acquired 3D peripheral MRA in a healthy volunteer. Note the overlapping FOVs in a). However, better depiction of small intramuscular arterial branches is seen due to improved spatial resolution in the lower two stations compared to continuous moving technique c) shows the MIP of a 39 y female patient with PAOD (Fontaine grade IV). Multiple stenoses and occlusions of the lower limb arteries can be depicted and were confirmed by conventional 3D MRA.

References:

(1) Meaney J.F.M., Eur Radiol 13:836-852, 2003
(2) Kruger D.G. et al., MRM 47 :224-231, 2002
(3) Herborn C.U. et al., Radiology 230(3): 872-8, 2004