

HIGH-RESOLUTION IMAGING OF THE SUPERFICIAL CRANIAL ARTERIES USING HIGHLY-PARALLEL RECEIVE COILS

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PURPOSE: Giant-cell arteritis (GCA) is the most common vasculitis. The superficial cranial arteries and the large extra-cranial arteries can be involved in adults of age over 50 years [1]. Diagnostic gold standard is biopsy of the superficial temporal artery [2]. False-negative results may occur due to the segmental pattern of affection [1]. In this context, MRI has proven to be a reliable tool for the depiction of the inflamed cranial artery segments [3]. Since sub-mm resolution is required for this purpose, higher field strengths (e.g. 3T) and dedicated RF parallel receive array coils are favorable. We evaluated the performance of 2 high-end coils for the imaging of superficial temporal and occipital arteries' wall in healthy volunteers.

METHODS: All measurements were performed on a 3T whole body scanner (Trio a TIM System, Siemens Healthcare, Erlangen, Germany). In 10 measurement sessions, 6 different healthy volunteers (4 males / 2 females, age mean \pm SD = 31 \pm 11) were examined without contrast agent using two different head coils: "32CH" a commercially available 32-channel array coil (Siemens Healthcare, Erlangen, Germany), and "95CH" a custom built 95-channel array coil [4] with circular receive elements of ~5cm diameter (Fig.1). For 95CH, a subset of 32 coil elements was selected to cover the superficial temporal and occipital arteries, i.e. a U-shaped axial band of ~1/3 of the coil's total surface coverage (all of the 95 coil elements were actively detuned during RF transmit). This corresponds to the most focused spatial coverage of the GCA region of interest that is possible with Trio's 32 receive channels. The following T1 weighted Spin Echo sequences were used (all with TE/TR=20/500ms, FA=90deg, 3mm thick slice, 0.2-0.3mm in-plane resolution, fat saturation): (SeqA) image matrix 1024x768, partial Fourier (phase) 75%; (SeqB) image matrix 1024x768, GRAPPA factor 2; (SeqC) image matrix 1024x1024, GRAPPA factor 2. The measurement time was 4min 52sec (SeqA & SeqC) / 3min 25sec (SeqB) for 10 axial slices.

Fig.1: 95-channel experimental coil [4], front view.

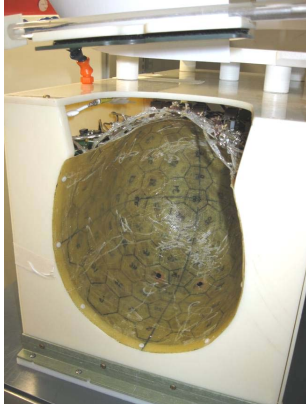
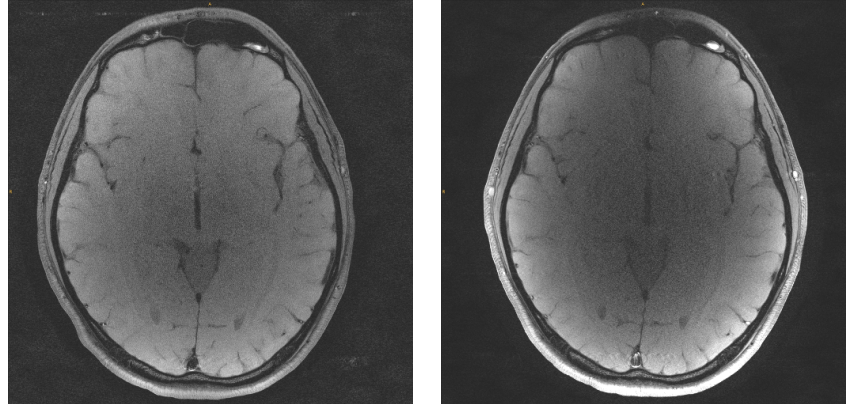


Fig.2: sample axial slices. Left: 32CH coil SeqA; Right: 95CH coil SeqB.



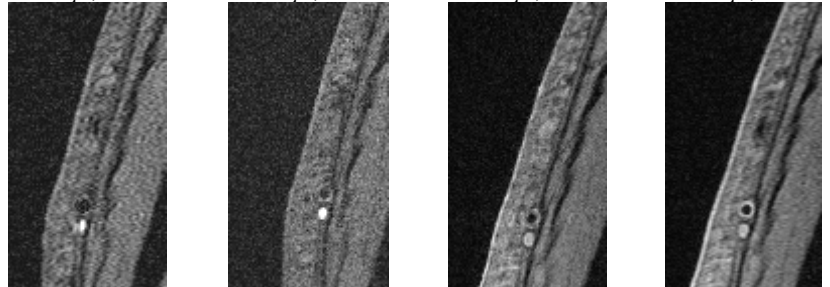
RESULTS: Compared to the standard 32CH coil, an experienced radiologist found the images from the 95CH coil (Figs.2-3) to be qualitatively more detailed and less noisy in the regions of interest (superficial temporal and occipital). The average SNR in the right superficial temporal area obtained in the same measurement time by 32CH-SeqA versus 95CH-SeqC (with in-plane resolution 0.2x0.3mm respectively 0.2x0.2mm) for the 6 volunteers was 11 \pm 2.3 versus 20 \pm 3.3 (mean \pm SD).

DISCUSSION & CONCLUSION: The results show that clearly improved image quality can be achieved with the more focused coverage of the 95CH coil, together with higher in-plane resolution or with a shorter measurement time (clinical use typically requires 3 adjacent sets of 10 axial slices).

The benefit could be even more significant for clinical cases when contrast agent is contraindicated, and may even allow it to be avoided altogether [5]. However, the improved quality holds only for the region of interest (superficial temporal & occipital): the image quality in the other head regions (e.g. frontal and centre) is decreased with the 95CH coil (Fig.2). Compared to the product 32CH coil, the experimental 95CH coil has a tighter, monolithic inner shell, less comfortable for the subject. However, only 1/3 of the full head coil is actually used, so a more comfortable U-shaped coil could be built for this purpose. To conclude, the higher-end 95CH coil showed great potential for this clinical application, and a study is in preparation to evaluate its benefit on patients, with and without contrast agent.

Fig.3: zoom-in on a right superficial temporal artery.

32CH SeqA; SNR=9.4 32CH SeqC; SNR=8.2 95CH SeqC; SNR=15 95CH SeqB; SNR=19



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