A Novel "Smart" Neurovascular Array Coil System for Parallel Imaging

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Synopsis

A conventional neurovascular coil is often made available as an optional coil, so the operators end up with purchasing both a head coil and a neurovascular coil because of different requirements for ROI. As a result, this practice takes excessive cost and leads to lower throughput to have both coils. A noble neurovascular array coil system is proposed, which is a hybrid design of a multi-element head array coil and an additional array coil to cover from neck to upper thorax. The proposed design is capable of parallel imaging (PI).

Introduction

Array coil technology is a key technology in fast imaging techniques using PI. Various array coils, including neurovascular array coils [1,2], have been developed. These neurovascular coils are made available as optional coils. An operator must exchange a head coil with a neurovascular coil whenever the ROI gets changed from head to head-and-neck (i.e., neurovascular). This practice requires more cost and leads to lower throughput due to maintaining the two coils.

We have developed a new head array coil for head PI, which contains four linear coils and three QD coils. This head array coil can be extended to a neurovascular array coil system (NVAC) by "Smart" addition of add-on neck / upper thorax array piece.

Methods

A head array coil has been constructed based upon the previously reported QD 4-channel array coil for f-MRI [3], which has two top figure-eight coils on a head crown, three QD surface coils around a head and two linear coils in front of a chin (Figure 1). The chin coils are attached to the head cover through connectors. When the head array coil is extended to the NVAC, four linear coils, anterior and posterior array coils, are attached with the original chin coils removed. The anterior array is connected through the same connector as those of the chin coils, and the posterior array is set on the back of the head array coil cover (Figure 2). Figure 3 shows each coil element pattern, which is aligned to both X and Y directions to cover neck and upper thorax. The neck part of the anterior array coil is covered with flexible foam to conform to the shape of a neck. The NVAC has eight output channels, which consist of four channels from the head portion (the signal lines of two eight-figure coils are combined) and four channels from attached four linear coils. The NVAC can be interfaced with both 8-channel and 4-channel receiver systems by signal selection or combining.

A prototype of this NVAC was built, and measurements were made on 1.5T EXCELART^{TM} system using both phantom and volunteers. The SNR of the NVAC was compared with our standard QD head and CTL coils.

Results and Discussion

The NVAC yielded 15% more SNR for head imaging than the QD head coil at a head center. While the SNR of the NVAC was 20% lower in the cervical region than that obtained by the CTL coil, SNR achieved in the anterior region of upper thorax was higher by more than 80%. Figure 4 shows a volunteer image of TOF-MRA from an aorta to a head, which was obtained using the PI with R=2.0. This result shows a wide coverage from upper thorax to head with high SNR and capability of PI.

Conclusion

The NVAC has proven to be a successful coil from its clinical standpoint owing to its high SNR profile and a wide coverage from upper thorax to head. Moreover, the most notable feature is that the NVAC is a head array coil with a removal add-on neck / upper thorax array piece, making the NVAC "Smart" Array.

References

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[2] X. Yang, et al., Proc. of ISMRM, p. 2368, (2003)
[3] Y. Hamamura, et al., Proc. of ISMRM, p. 738, (1999).

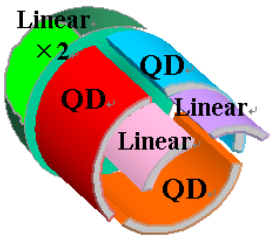


Figure 1
New head array coil

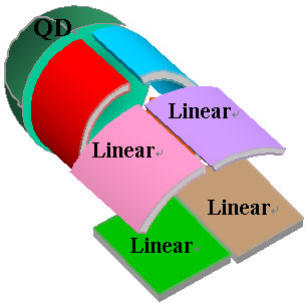
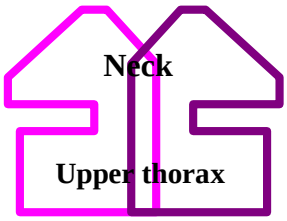
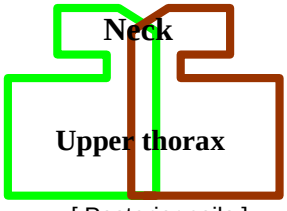


Figure 2
New neurovascular array coil



[Anterior coils]



[Posterior coils]

Figure 3 Coil patterns of attached arrays

Figure 4 TOF-MRA
TR/TE=30/6 ms
Reso. : 1.7mm*0.9mm*2mm
8min.42sec