Effects of channel numbers on Signal-to-Noise Ratio in multi T/Rx coils at 7.0 Tesla

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Introduction A phased array coils close to the body have benefit of increased SNR[1] and the additional benefit of decreasing center brightening effect. This study was designed to compare the performance of multi channel T/Rx coils with different number of channels. There is a comparison study of Rx-only coil with different number of channels in close-fit helmet coil, it proved more number of channel coil improves the SNR of peripheral area in circular type surface coil. [2] As the number of channel increased, the area of each channel cover is lessened which may affect to the some aspects, in terms of the SNR[1], Tx power consumption, and the image homogeneity. All coils were constructed and were evaluated for the same dimensions. The 6 channel multi channel T/Rx coils displayed best SNR in central and peripheral area. But our research suggests that 8 and 4 channel multi T/Rx coil showed minimized center bright effect with slightly less SNR compared to 6 channel coil. The conclusion, we may use different number of channels coils with different characteristic with purpose of studies. The coils using in this study designed in same diameter and height except the number of channels. Different characteristic of compartments were used due to different channels numbers such as T/R switches and power splitters may affect the results.

Methods The system was developed and tested on a prototype 7T human scanner (Siemens Medical Solutions, Erlangen, Germany). All coils were manufactured on a 270mm cylinder acryl case and were matched to 50Ω while loaded with a phantom and a human brain.(Fig.3) Rectangular surface coils were placed on a cylinder, and were designed to a same dimensions, 150 mm of height, and the same channel distance of 13mm. The four coils each channel connected with phase difference for circular polarized Tx mode. The signal-to-noise ratio and the effective delivered Tx power for coils were compared by the use of T2* weighted MR contrast imaging based on a gradient recalled echo(GRE) sequence.

Results For SNR of the phantom on a central axial slice along the left-right direction, 6 channels coil shows highest SNR in central and peripheral region, while 8 and 4 channel coils displays slightly less SNR, and 2 channel coil has poorest SNR result among 4 coils.(Fig.1) For SNR of the human on a central axial slice along the left-right direction, 4, 6, and 8 multi channel coil showed similar result, while the 2 channel coil performed worst result.(Fig.2) For homogeneity of the phantom image, 6 and 8 channel coils performed the most homogeneity as compared to other coils, while strong darkening effect occurs in 4 channel coil around the center area and 2 channel coil showed inhomogeneous image.(Fig.4) In terms of Tx power consumption of multi T/Rx coils, 4, 6, and 8 channel coils have similar Tx power calibration in same condition while 2 channel coil needs more than 30% higher power. (Table. 1)

Conclusion The 6 channel multi T/Rx coil showed the best SNR in central and peripheral area while the 8 and 4 channel showed slightly less SNR compare to the 6 channel coil. And we proved 2 channel coil has no specific advantages which has low SNR and high Tx power consumption compared to 4, 6, and 8 channel coils. We prefer to use 8 channel multi T/Rx coil which is more useful for parallel imaging techniques than the 4 and 6 channel coils but it has similar performance of the SNR and the Tx power consumption. The 6 channel coil may be useful for some area of angiography studies which need big difference of the center area and near peripheral area.

References

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