Development of Stable Cryo Probe and HTS Helmholtz Coil for Clinical Application

J. Liu[1], C. W. Hu[1], and Q. Y. Ma[1]

[1]Time Medical Inc., Shanghai, China, People's Republic of

Introduction

High temperature superconducting (HTS) coils have shown great improvement not only in SNR gain but also in penetration depth [1][2]. Now a reliable cryo-probe for HTS coil has been designed and developed for clinical applications.

Design and Development

Previous work done with HTS coil had been a research demonstration with HTS coil merged in liquid nitrogen (LN_2) which is impractical for clinical use. A new vacuum insulated cryo-probe with HTS coil and array is developed for clinical applications. In the new design, the HTS coil is in contact with a cold head made of a ceramic. The cold head is cooled by LN_2 in a small tank (500mL), which is thermally insulated by vacuum inside the probe. It takes 15~20 minutes to cool the HTS coil from room temperature to 80K. The new cryo-probe could continually work over 8 hours in clinical MR setting and the HTS coil is stable in operation. The unloaded Q of the HTS coil in the probe is around 6000.

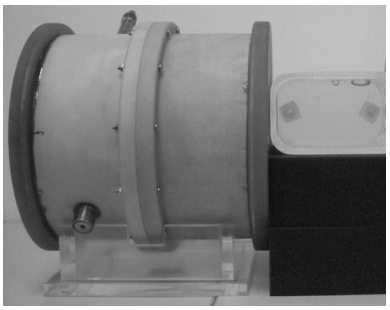

Fig.1 HTS Cryo-probe

This probe has been already tested in both low field system (Time Medical Mona system 0.2T) [3] and high field 3T commercial systems. A two channel HTS Helmholtz probe is also designed and tested for orthopedic imaging.

Results

Fig.2 shows the comparison wrist images using normal copper coil and our HTS probe in Timed Mona 0.2T.

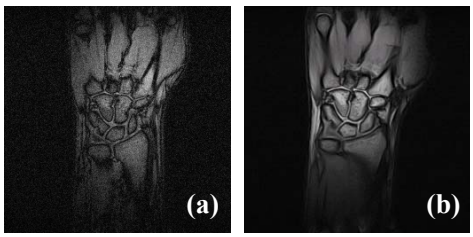

Fig.2 GRE Wrist Images (a) Copper; (b) HTS

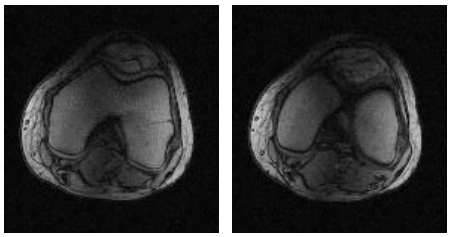

Fig.3 Knee Images (TR 400/TE 15/ST 5/NEX 1)

Fig.3 is a combined knee image using a two channel HTS Helmholtz probe in Timed Mona 0.2T with Gradient Echo sequence.

Conclusions

A reliable cryo-probe for HTS coil is developed for clinical application. With this probe, HTS surface and Helmholtz coils have been tested for orthopedic imaging with improvement of both SNR and penetration depth.

Ref:

[1] Erzhen Gao et al., "Superconducting MR Helmholtz Coil pair for Human Imaging with Improved Penetration", Proc. Intl. Soc. Mag. Reson. Med 9 (2001)

[2] M.S. Chow et al., "A Two-Channel HTS Thin-Film Phased Array Coil For Low Field MRI", Proc. Intl. Soc. Mag. Reson. Med 11 (2003)

[3] Jack Liu et al., "Development of Superconducting RF Probe for Low Field Orthopedic Imaging", Proc. ISMRM (2009)