Open Vertical Mobile 0.22T MRI System for Veterinary/Human Extremities Imaging

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Introduction

MRI has been widely used for clinical diagnosis in hospital. But most veterinary hospitals still cannot benefit from this technology in treating large-size animals like horses because of the difficulty in accessing the conventional high field system[1] and the high cost of both purchasing and maintaining a MRI system. And the noise generated by the gradient coil is also a problem for the living animals to stand still while imaging.

Although an open, low cost permanent magnet system has been introduced[2], a living horse to be imaged has to be anaesthetized due to the H-shape opening. Here we report a low field (0.22T), open mobile system for human and animal imaging that can image living animals like horse without anesthetization.

The C-shape permanent magnet with a horizontal field was designed to have vertical opening for a person or a live animal like horse. Instead of a fixed RF-shielded room, a flexible RF shield facility was adapted and wheels were used under the magnet so that the system could be moved easily.

Magnet Construction and performance

Figure 1 shows the open vertical magnet with an un-anesthetized living horse in a image-ready position. The magnet consists of a pair of donut-type poles with a diameter of 50cm, a gap of 20cm with roughly 12cm sphere of homogeneity volume (33 ppm), and passive shimmed. In order to move the magnet (800 kg), four non-magnetic wheels are installed on the iron frame to support the magnet.

Fig. 1 The open vertical Magnet with a live horse

Hardware system

Two planar gradient coils are placed on both sides of the magnet. The maximum gradient strength is 10mT/m along each of directions and there is no gradient switching noise when the system is in operation. A transmit-receive RF coil is built for imaging[3].

Imaging Protocol

The control of the prototype system was built with a PC-based commercial console (Apollo, Tecmag Inc, Houston, TX). A user interface implemented in the console provides both the routine clinical control and specific research capability. The software is able to program the pulse sequence graphically, and to re-construct and process the image. Several pulse sequences are implemented in our system: SE, GRE, 3D-SE, 3D-GRE, FSE and FLAIR.

Results and Discussions

The prototype demonstrated the potential for the routine applications of MRI in the clinical diagnosis and also in the veterinary field. With the vertical open design, a person could stand, sit on a chair or even lie down on a table, and a living horse could also be in a standing position when being screened.

Figure 2 showed the wrist images with the thickness of 4mm and 1.2mm respectively. Figure 3 showed the image of horse carpal bone with scanning time around 2 minutes, which was short enough for horse to stand still in the magnet.

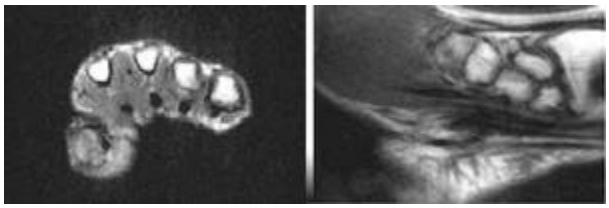

Fig. 2. Cross sectional image of human wrist acquired with (LEFT) 2DSE: TR/TE/NEX/Thk = 800/30/2/4mm (RIGHT) 3DGE: TR/TE/NEX/Thk=800/30/2/1.2mm

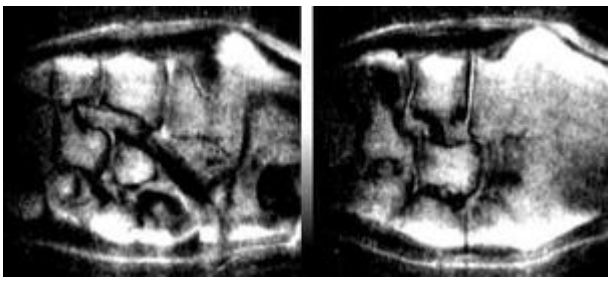

Fig.3. Coronal images of the Horse Carpal bones with TR/600;TE 23, FOV 16/10; 256x256/2NEX

Conclusion

An open, mobile, quiet and easy-to-use MRI system has been developed for human/veterinary 2D/3D imaging. The vertical opening also has the possibility of imaging large animals like horses.

Acknowledgments

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References

1. A.J. Kaneps, et. al., Veterinary Radiology and Ultrasound 36, 467-477,1995
2. P. Choquet, et. al., The Veterinary Record, 146,616-617,2000
3. GX. Shen, Proc ISMRM, P.4048,1992