

Fundamental Background for 3T MRI/MRS

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At present, the trend of magnetic field strength in MRI system is dramatically changing. In early 70, the only low field (<0.5T) was developed. It was technically difficult to develop the high field system. At that time, people believed that the fine MR imaging could not be obtained in the high field MR system due to the magnetic susceptibility effect. However, 1.5T system was evolved at the end of 80, and used for clinical usage. Thus, it was proved that the signal to noise ratio (SNR) could be greatly contribute to enhance the image quality. And, the results of functional MRI and MR spectroscopy could be improved in the higher field MR system. So, 8T system was eventually developed in Ohio State University Hospital at the end of 90. Therefore, there is no doubt that the system with the ultra high magnetic field strength will be developed near future in 21 century.

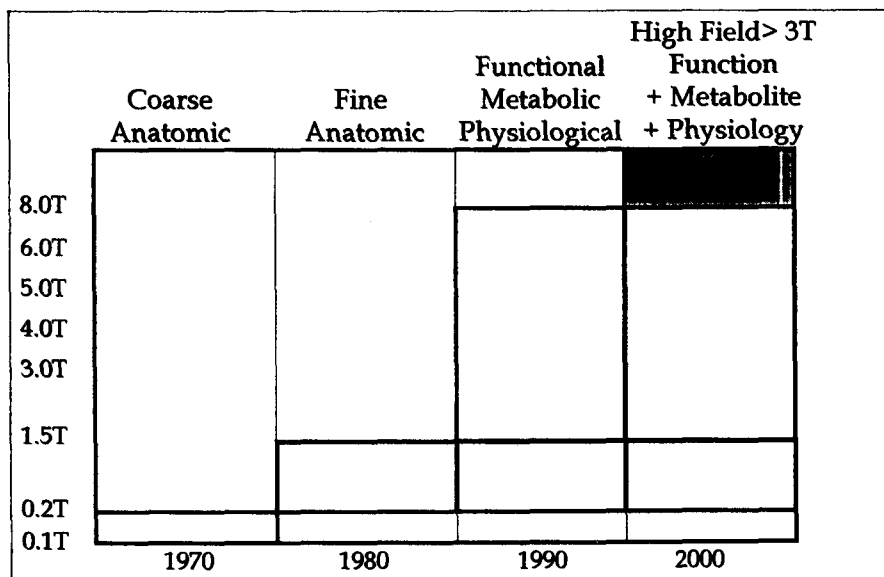


Figure. Trend of magnetic field strength

In this 21 Century, the market of 3T system is dramatically growing worldwide. Within next 3 years, the market of 3T will be double, while that of 1.5T will be stable. And, the market of the low field system like 0.5T and 1T will be significantly decreased.

The main advantage of 3T system is based on the signal to noise ratio (SNR). Compared with 1.5T, SNR of 3T system is 2.5 times greater. This advantage can help to distinguish the very tiny mass in the early stage of tumors. Also, it can reduce the scan time, and accelerate the capability of handling patients.

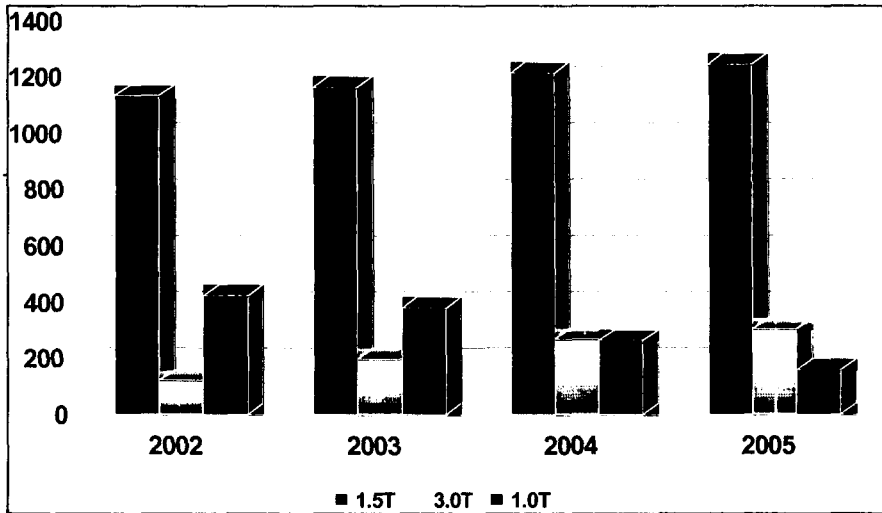


Figure. World 3T Market (\$Million)

Moreover, 3T system can provide the high resolution MR images with matrix, 1024x1024, and fine thin slice thickness with 1 mm. Also, it is convenient for the fast scan with EPI. And, spectral resolution will be greatly enhanced. Thus, complex spectra with overlapping peaks could be well resolved.

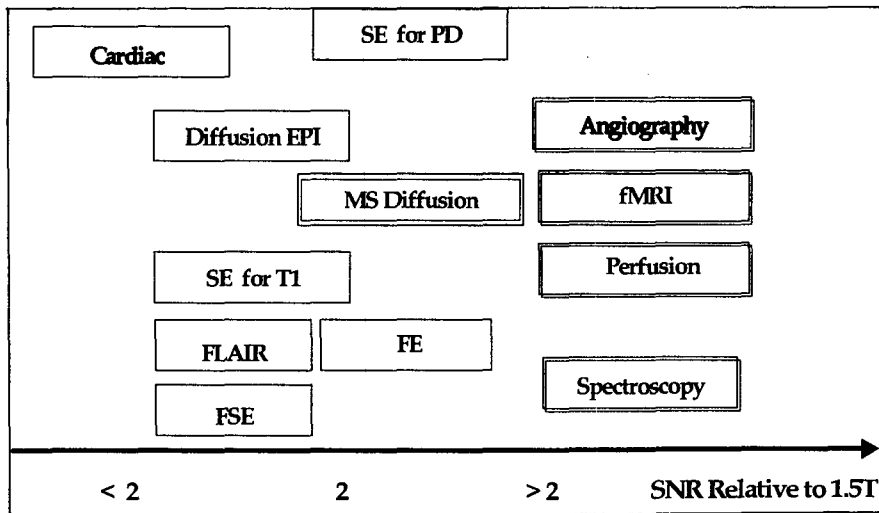


Figure. 3T advantage over 1.5T

In terms of efficiency and sensitivity, the applications of angiography, fMRI, perfusion, spectroscopy with 3T are twice greater than those with 1.5T.

FDA clearance for all applications of 3T MRI such as brain/body imaging, diffusion tensor, fMRI, MRS was achieved at August, 2001. FDA approval of 4T MRI will be expected soon.

During the development of 3T whole body MRI/MRS system with the world first active shield magnet, the preliminary results of conventional MRI, functional MRI (fMRI) and magnetic resonance spectroscopy (MRS) will be presented. The dimensions of active shield magnet are 2575 mm height, 2347 mm length, 2208 mm width, 7500 kg weight and 840 mm horizontal bore inner diameter. A gradient coil for 3T MRI system was manufactured by Tesla Co. Since July 1997, the procedure of MR image improvement and system stabilization was going on until now. Thus, the diagnostic quality of MR images was nearly able to obtain in the present 3T MRI system. All the routine scans could be currently managed below the FDA safety guideline.

According to the road map with Phase II, advanced and clinical features are going to design and equip in the 3T MRI system. In particular, ultrafast techniques (i.e., EPI) fMRI and MRS are actively developing now. Using a FLASH pulse sequence, we have performed fMRI with the simple experimental protocols such as visual, motor and sensory activation. So far, quite reasonable results were successfully obtained .

A STEAM pulse sequence for MRS was designed. Localized stimulated echo images with and without water-suppression were successfully obtained. The percentage of water suppression is currently 70%, but plan to have upto 100%. Based on the initial experiences, we obtained the well-resolved phantom spectrum and in-vivo human spectrum. However, the postprocessing software should be prepared soon.

Over the 18 months uses of active shield 3T magnet, we have not had any serious problem such as an unexpected magnetic quench. Our initial experience may suggest that the active shield 3.0T magnet can works flawlessly in the clinical situation and appears to be proper choice for the high field magnetic resonance applications such as fMRI and MRS. We expect that the commercial version could be possible in near future.