FASCINATE: Development of New Pulse Sequence for Simultaneous Acquisition of T2 Weighted and Fluid Attenuated Imaging

K. Takeo¹, A. Ishikawa¹, M. Okazaki¹, S. Kohno¹, K. Shimizu¹  
¹SHIMADZU corporation, Kyoto, Kyoto, Japan

Introduction
In brain MR imaging, both T2 weighted sequence and Fluid Attenuated Inversion Recovery (FLAIR) sequence are widely used at most hospitals. Currently, the FLAIR sequence is usually used in addition to the T2 weighted sequence, and it is expected to provide additional information. In this study, we developed a new pulse sequence which enables simultaneous acquisition of both T2 weighted image and fluid attenuated image to reduce the examination time. We refer to this sequence as FASCINATE (Fluid Attenuated Scan Combined with Interleaved Non-Attenuation).

Methods
The preparation of magnetization in FASCINATE for fluid attenuated image is based on the technique which was referred to as “driven inversion” in Ref.1. A basic driven Inversion technique consists of 90(\(x\))-180(\(y\))-90(\(x\)) pulse combination and at the point of last 90(\(x\)) pulse, the remaining transverse magnetization are forced to invert. Recently, the application of this technique to FLAIR sequence was reported (2). More recently, Ishikawa et al (3) reported the use of driven inversion as the post acquisition pulse of fast spin echo sequence. We extended this idea and designed FASCINATE sequence. In FASCINATE, the fast SE acquisition with additional 180(\(y\))-90(\(x\)) are used for T2 weighted imaging(Fig.1). This part is exploited as it is as the preparation pulse of following fast FLAIR acquisition. By waiting an appropriate TI period which nulls the longitudinal magnetization of CSF, fluid attenuation and T2 weighting is achieved in FN-FLAIR acquisition by the use of long effective echo time(TE). The FASCINATE sequence was implemented on a 1.5T MAGNEX EPIS15 system(Shimadzu, Japan). The brain images of a normal volunteer were obtained by T2 weighted fast SE, fast FLAIR and FASCINATE. With this TR, the optimum TI that null CSF signal were experimentally found for FLAIR and FASCINATE respectively by scanning with various different TIs. With these TR and TI, we compared the images of FLAIR and FASCINATE-FLAIR(FN-FLAIR). The images of FASCINATE-T2(FN-T2) and T2 weighte fast SE with TR=4500ms were also compared. The other scanning parameters which were common for all sequences were : effective TE=110ms, number of echoes=9, echo interval=22ms, FOV=230mmX200mm, Thickness/Gap=7mm.1.5mm, Number of slices=14, matrix=256x198. Average=1, Scan Time=3’15”(FLAIR,FASCINATE), 1’57(T2 fast SE).

Results
The optimum TI of FLAIR and FASCINATE were 1800ms and 1710ms respectively. Fig.2. compares the images of T2 fast SE(a), FLAIR(b), FN- T2 (c) and FN-FLAIR(d). The image appearance of FN-FLAIR was very similar to that of FLAIR, and FN-T2 image was virtually identical to T2 image except for the signal difference caused by MT effect. A total scanning time to obtain T2 weighted and fluid attenuated images was greatly reduced by using FASCINATE.

Conclusion
We have developed a novel pulse sequence (FASCINATE) that enables simultaneous acquisition of T2 weighted image and fluid attenuated image. This sequence has a possibility to replace the combination of fast FLAIR and T2 fast SE scans to reduce the examination time.

References

Fig.1. A simplified timing diagram of FASCINATE sequence and evolution of transverse and longitudinal magnetization of brain(solid) and CSF(dashed).

Fig.2. Images obtained from normal volunteer  
a:T2 fast SE , b:fast FLAIR, c:FN-T2, d:FN-FLAIR  
Image c and d were acquired simultaneously.