30 Fast Spin Echo: Reduced Refocusing Angle

Although the reduction in measurement time using fast spin echo (FSE) technique is desirable (and plays a fundamental role in clinical imaging today), the very use of multiple closely spaced refocusing pulses is associated with higher RF power deposition. Thus, an FSE sequence may approach the acceptable limits of specific absorption rate (SAR) relative to patient safety. A common solution to this SAR problem is the use of a refocusing flip angle less than 180° (such as 120°, **Fig. 30.1**), leading to a marked reduction in SAR (which is proportional to the square of the flip angle) at the cost of signal-to-noise ratio (SNR). A refocusing pulse of less than 180° can be considered an insufficient flipping of the transverse magnetization. The induced MR signal is diminished, because it is proportional to the part of the magnetization projected onto the transverse plane. With a 180° pulse, the entire magnetization returns to lie within the transverse plane. Tilting the net magnetization back and forth with a low flip angle refocusing pulse leads to a so-called pseudo–steady state. Current approaches to decrease power deposition at 3 T with methods like variable flip angle imaging are not to be confused with the simple reduction of the refocusing flip angle in FSE imaging.

Fig. 30.1 illustrates T2-weighted FSE (TSE) scans in a patient with a large chronic left middle cerebral artery infarct acquired at 3 T with a flip angle of (a) 180° as opposed to (b) 120°. Although there is a reduction in SNR for white matter of 20% with the lower refocusing pulse, this is barely perceptible to the average radiologist. Due to SAR constraints, less than half the number of slices could be acquired when the 180° pulse was employed as opposed to the 120° pulse, using otherwise identical scan parameters. Coverage of the entire brain was thus not possible with the 180° pulse, illustrating the marked clinical applicability of a simple reduction in refocusing flip angle.

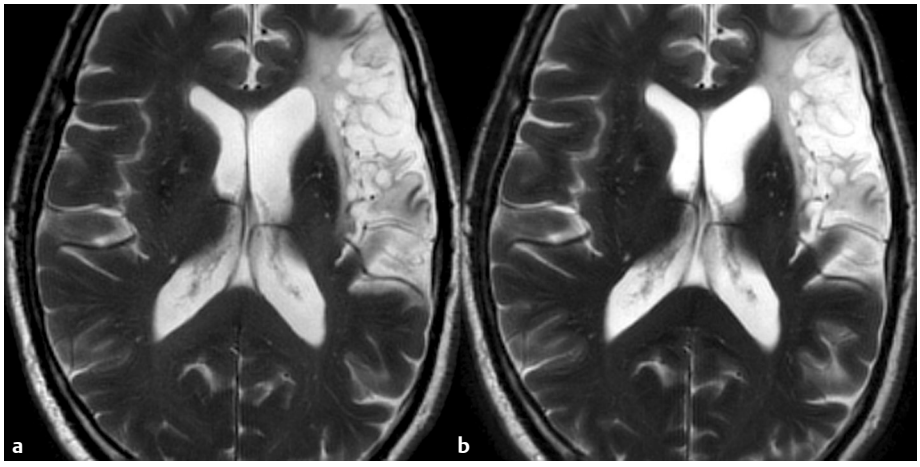

Fig. 30.1