PDW TSE orthopedic imaging

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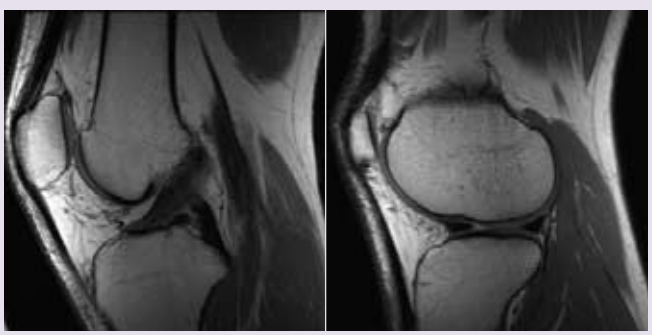
The TSE PDW (proton density-weighted) sequence is widely used for diagnostic imaging in orthopedics. This application tip focuses on joint imaging – in particular on image contrast and the reduction of imaging blurring, and on time-efficient PDW imaging with asymmetric TSE.

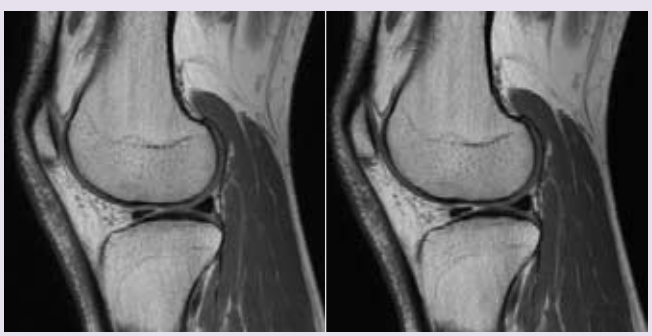
Optimize TE/TR for good contrast

Typically, PDW contrast is characterized by intermediate articular cartilage signal, lower meniscus, ligament and tendon signal and high synovial fluid signal. Use a TE of about 30 ms and a TR between 4000 ms and 5000 ms to easily achieve this contrast. Note that a relatively short TE (TE <25ms) might increase the risk of magic angle artifact.

When using a relatively short TR (e.g. TR <2500 ms), DRIVE helps to maintain high fluid signal.



Asymmetric TSE. Achieva 1.5T, TE 30 ms, TR 5000 ms, voxel size 0.41 x 0.63 x 3 mm, scan time: 3 min.



TR 2500 ms, without DRIVE. TR 2500 ms, with DRIVE.

Optimize TSE shot length to control image blurring

In TSE imaging, tissues with shorter T2 relaxation times (such as articular cartilage, bone marrow and muscle) produce more blurring than those with longer T2's. TSE shot length is the most important parameter to control image blurring for a given TSE profile order and TE. TSE shot length is displayed on the Info page.

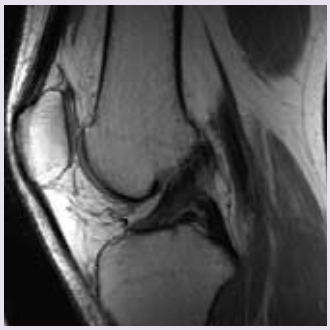
Linear halfscan PDW TSE is a clinically practical sequence. The challenge in using linear halfscan is to control TSE shot length when modifying other parameters. In addition, the images have relatively low SNR. Echo spacing and TSE shot length change when the halfscan factor, TSE factor and TE are modified. When using TE 30 ms, keep TSE shot length <100 ms to obtain sharp PDW images. A halfscan factor >0.65 is recommended.

In **low-high TSE**, raising TE increases echo spacing and TSE shot length, thereby increasing image blurring. For a TE of 20-35 ms, typical for PDW imaging, using start-up echoes is a way to control echo spacing and TSE shot length. Keep TSE shot length <80 ms to minimize image blurring. Challenges include long scan time and the time-consuming start up echoes.

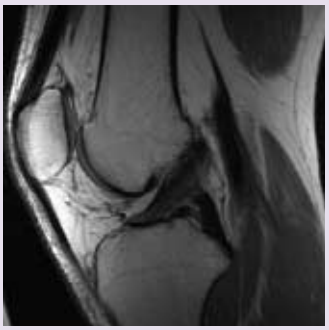
Asymmetric TSE is a new functionality that provides time-efficient PDW imaging: high TSE factors can be used. This allows selection of echo spacing and TE independently. The TSE shot length is easy to control via the TSE factor and echo spacing, while TE can be freely selected. For a TE of 30 ms, keep the TSE shot length <130 ms to acquire sharp PDW images.

Asymmetric TSE with fat suppression

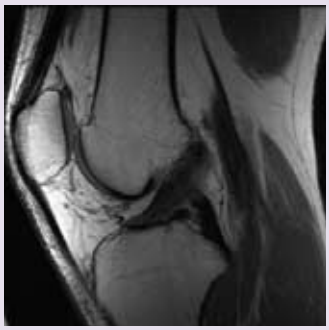
Fat-suppressed (STIR or SPAIR) scans are faster when combined with asymmetric TSE. For a specified resolution, adjusting echo spacing controls the number of packages. When TR is set as shortest, a long echo spacing (10-14 ms) will produce a one-package scan. Decreasing echo spacing to 6-9 ms easily provides a two-package scan. When using TE 30 ms, keep TSE shot length <130 ms to obtain sharp images.



Linear halfscan TSE
shot length 95 ms,
scan time 3 min.



Low-high TSE
2 startup echoes, shot length
80 ms, scan time 5 min.



Asymmetric TSE
shot length 130 ms,
scan time 3 min.

Achieva 1.5T,
TR 5000 ms, TE 30 ms,
echo spacing 10 ms,
voxel size 0.41 x 0.63 x 3.0 mm.

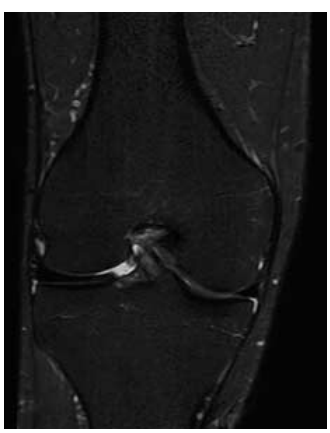
Asymmetric TSE with fat suppression

Low-high, 4:30 min.
TSE factor 8, 2 startup echoes,
shot length 80 ms,
echo spacing 10 ms,
actual TR 4900 ms,
1 package.

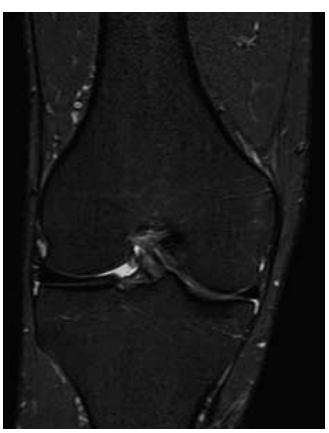
Asymmetric, 3:20 min.
TSE factor 12,
shot length 120 ms,
echo spacing 10 ms,
actual TR 5400 ms,
1 package.

Asymmetric, 2:20 min.
TSE factor 18,
shot length 126 ms,
echo spacing 7 ms,
actual TR 2700 ms,
2 packages.

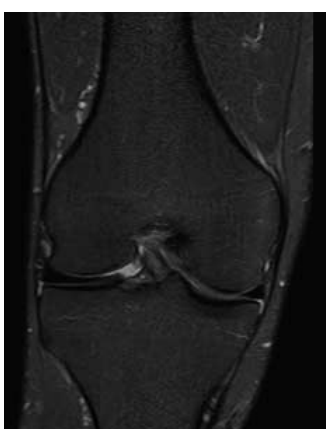
PDW TSE SPAIR
Achieva 1.5T,
TE 30 ms,
TR shortest.



Low-high, 4 min.
TSE factor 8, 2 startup echoes,
shot length 80 ms,
echo spacing 10 ms,
actual TR 4900 ms,
1 package.



Asymmetric, 3 min.
TSE factor 10,
shot length 100 ms,
echo spacing 10 ms,
actual TR 4900 ms,
1 package.



Asymmetric, 2 min.
TSE factor 15,
shot length 98 ms,
echo spacing 6.5 ms,
actual TR 2400 ms,
2 packages.

Short TE STIR
Achieva 1.5T,
TE 30 ms,
TR shortest,
IR 135 ms.