

Cross Talk

Appearance:

Cause: - Energy transfer.

- Act of nature when nuclei relax to B_0 and transfer energy to adjacent nuclei.
- The nuclei lose their energy due to spin lattice relaxation and may dissipate the energy to nuclei in neighboring slices.

Cure: - Can never be eliminated: caused by the natural dissipation of energy by nuclei.

Cross Excitation

Appearance: - affects image contrast.

Cause: - RF delivered outside the slice.

- When nuclei adjacent to selected slice receive RF.
- RF pulse not square - width of pulse should be $1/2$ its amplitude, varies up to 10%; therefore nuclei in slices adjacent to RF excitation pulse may become excited by it.
- Adjacent slice receive energy from RF excitation pulse of their neighbors.
- Energy pushes the NMV of nuclei toward transverse plane so that it may become saturated when they themselves are excited.

Cure- for both Cross Talk and Excitation:

- Shinnar-Leroux RF pulses - increase TE, decrease # of slices
- Increase the slice gap - 20-50% for 5mm & up, 10-30% for 5mm and under.
- Interleave - decreases artifact when RF delivered to odd and then even numbered slices, allows time for cross talk artifact to decay. (double scan time).
- Avoid intersection of multi-oblique clusters or slices.

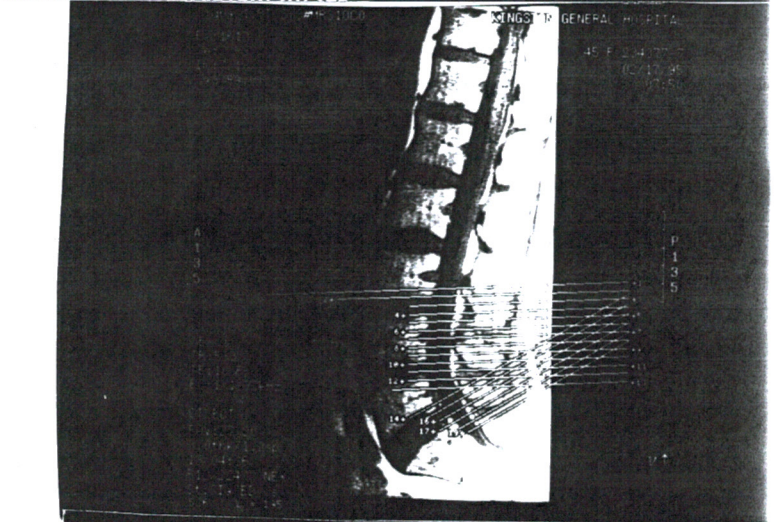
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Se:5/5
Im:15/19
DAx I132.3

45 F 23437
02/17
08

ET:4

FSE
TR:3316
TE:28/ET
EC:1/1 16kHz

CTLBOT
FOV:20x20
4.0thk/0.5sp
19/06:38
512x224/2 NEX
FCs/St:SIap/NP/VB/ED/SO/SPF



Signa 1.5T SXS/MRS1000
Ex:1613
Se:5/5
Im:15/19
DA: I132.3

KINGSTON GENERAL HOSPITAL
45 F 234377-7
02/17/95
08:09

ET:4

FSE
TR:3316
TE:28/ET
EC:1/1 16kHz

CTLBOT
FOV:20x20
4.0thk/0.5sp
19/06:38
512x224/2 NEX
FCs/St:SIap/NP/VB/ED/SO/SPF

Zipper Line Artifact

Appearance: - Alternating bright and dark line across the row.
- Frequency encoding direction (horizontal) center of image.

Cause: - Image data that avoided being phase encoded and have no extent in the phase encoding direction.
- Based on concept of stimulated echoes.
- When there is a sequence of 3 or more RF pulses,
i.e., multi slice/multi echo - possibility for stimulated echo formation.
- 3 RF pulses could be imperfect 90 , 180 , and 180 pulses of a 2 echo sequence, or could come from RF pulsed of adjacent slices.
- If phase encoding occurs between 2nd and 3rd RF pulses while spin component is parked longitudinally, this stimulated echo component will fail to be phase encoded; therefore when image is formed - assigned to central line in frequency encoding direction = zipper.
- Stray RF; leak in RF shield or from monitoring equipment.
- Improper transmit adjustment.
- Imperfect slice selection profile.

Cure: - Eliminated by choices of patterns of spoiler gradient.
- Remove monitoring equipment.
- Check transmit gain/ attenuator.
- Check that door is closed.

Central Point Artifact

(Rare)

Appearance: Bright or dark dot precisely at center of image.

Cause: - Results from a constant DC offset in the level of receiver voltage of each Phase encoding step.

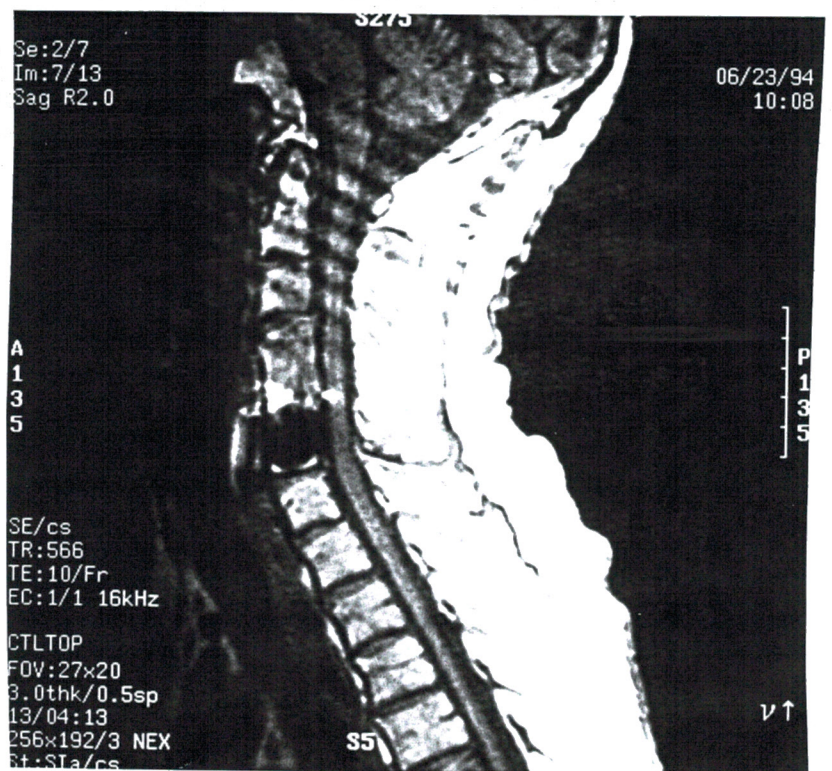
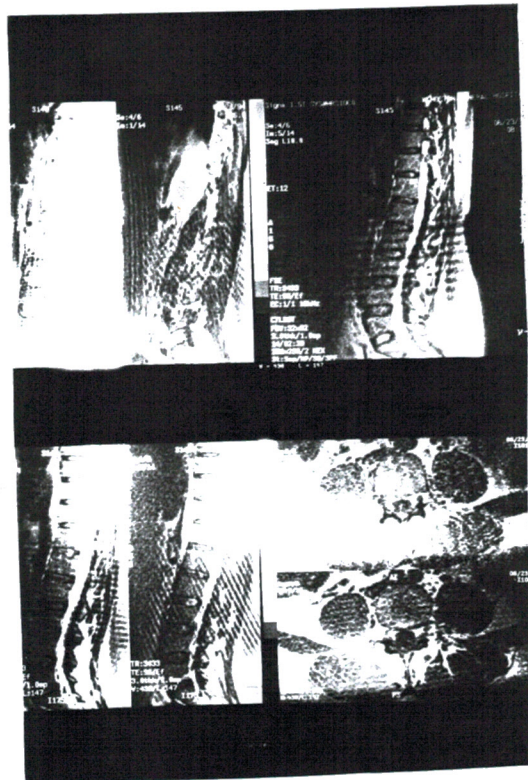
Rare: because of use of RF phase alternation and self-calibrating checks in scanner circuitry.

Zebra Artifact or Zero Filling

Appearance: - Stripes - vary in intensity, width and orientation.

Cause: - Data in K-space array missing or set to 0 by scanner.

- A spike of noise may occur At a point in K space.
- These abrupt changes in signal from one point to an adjacent point result in zebra stripes.



Ghost Artifacts/Phase Mismapping

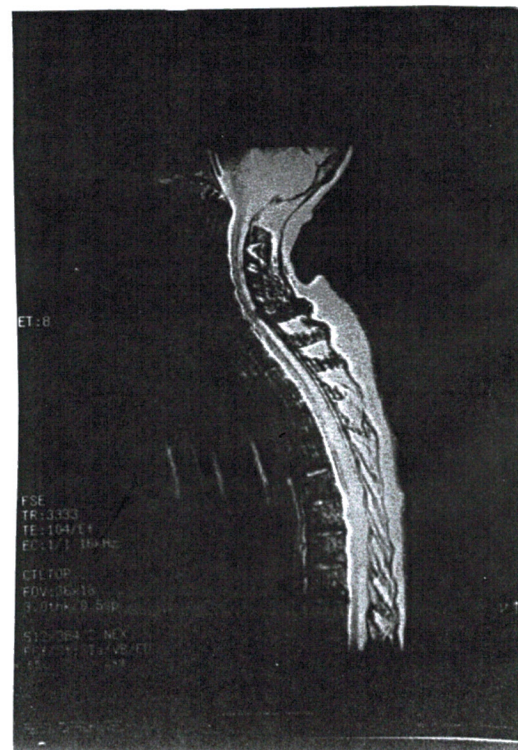
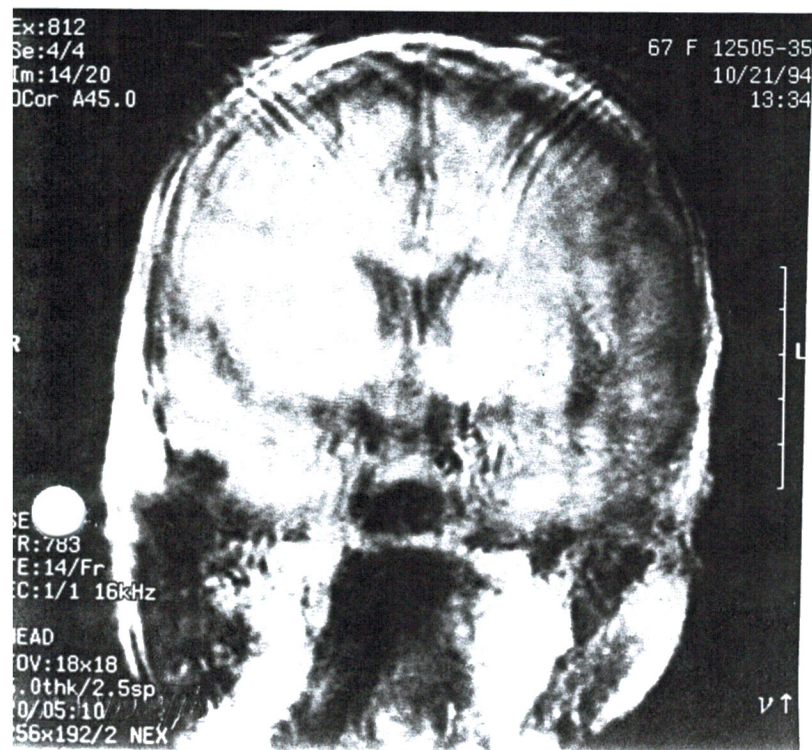
Appearance: - Appears as extra images, fainter than the main image, and displaced with respect to the main image.

Cause: - Occurs along the phase encoding direction, whenever a portion of the imaged structures within the FOV varies or moves in a periodic fashion.

i.e.. CSF/blood flow, cardiac motion, respiratory motion.

- Intensity of artifacts increases with the amplitude of motion, as well as with signal intensity of the moving tissue.
- Spacing of ghosts depends on principal direction of motion, magnitude of displacement and periodicity of motion - relative to the phase sampling interval.
- More rapid motion = more widely spaced.

- Cure:** -
- 1) Physical restraint of body motion.
 - 2) Suppression of signal from tissue generating the ghosts.
i.e.. use RF saturation bands, or use STIR sequences.
 - 3) Manipulation of imaging parameters- swap phase and frequency, increase NEX, increase FOV.
 - 4) Gating - cardiac, respiratory.
 - 5) Phase reordering, respiratory compensation.



Chemical Shift Artifact

Appearance: - With spin echo sequences: seen along the frequency encoded axis.

- Differences in the precessional frequencies for fat and H₂O, are slightly different for same external magnetic field - displayed as a slight shift in apparent location of signal source.
- At a fat and H₂O interface - artifact apparent
i.e.: if signal from H₂O is shifted 1 pixel to the right in relation to fat, at the interface there would be a low signal intensity at the left margin and a high signal at the right; since the Fourier Transform of the signal would indicate fat and H₂O were at the same location.
- Bright band at fat-muscle interface and dark band on opposite side; occurring along the frequency encoding direction.

Cause: - In the frequency direction, MRI use the frequency of the signal to indicate spatial position. Because fat and H₂O resonate at different frequencies, the MR scanner mistakes the frequency difference as positional (spatial), therefore fat structures are shifted in the frequency direction from their true position.

- Due to slight difference in Larmour frequency (225ppm) of the tissue at 1.5T.

- Due to chemical environments of fat and H₂O

fat= hydrogen + oxygen

H₂O= hydrogen + oxygen

Therefore fat precesses at a lower frequency than H₂O. This is proportional to the main magnetic field.

i.e.: at 1.5T fat processes 220Hz lower than H₂O

- Pixel shift of fat relative to H₂O = $\text{Larmor freq.} \times \text{PPM} = \text{freq. shift}$

$\Delta \text{armor frequency} \times \text{PPM} = \text{frequency shift}$

$\text{Frequency per pixel} = \frac{\text{receive bandwidth}}{\text{frequency matrix}}$

$\text{Pixel shift} = \frac{\text{frequency shift}}{\text{frequency per pixel}}$

$\text{Shift dimensions} = \text{pixel shift} \times \text{pixel dimension}$

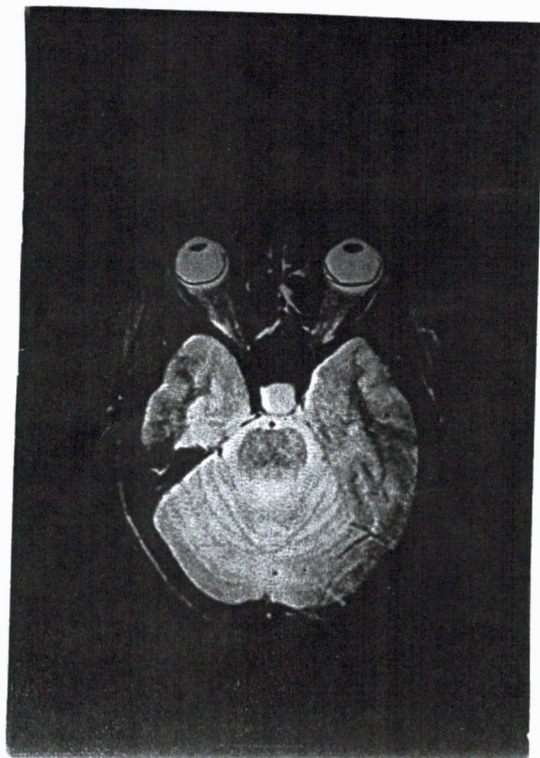
Cure: - Scan at lower field strengths.

- Decrease the FOVEA.
- Increase the receive bandwidth.
- Use fat sat.
- Swap the phase and frequency to reposition the artifact.

Where: Abdomen: black border at one interface and bright at the other.

Spine: causes 1 end plate to appear thicker.

Orbits: black border/bright border.



Herringbone, Grid-line, Crisscross

Appearance: -herring pattern; series of horizontal, vertical and oblique stripes across the image.

Causes: - data processing error; array processor faults; recon artifact.
- loss of any data lines or points.
- Due to magnetic gradient instability, excessive noise, tuning errors resulting in pulse jitter or other factors.
- A data error in processing Fourier transform

Cure: - Save raw data and reconstruct again.
- rescan.
- notify service.

