

How to Learn MRI

An Illustrated Workbook

Exercise 7: MRCP

Teaching Points:

- What is the effect of slice thickness on pancreatic duct visualization (partial volume averaging)?
- What is respiratory triggering?
- What is 2D MRCP and how to produce these images?
- What is 3D MRCP and how to produce these images?

The MRCP protocol shows a clear image of the biliary system. This is particularly helpful for patients who underwent liver transplant and those with biliary obstruction.

Step 1: Patient Prep

Refer to previous exercises.

Step 2: Prepare the room and coil

Cover the scanner table with a clean disposable sheet and the pillow with clean disposable pillowcase. Place the posterior portion of the cardiac coil on the table, about where your volunteer's liver will be. The respiratory bellows should also be there, so the volunteer can lay on top of it.

Step 3: Volunteer position, coil selection, and landmark

Have the volunteer lie supine on the table, feet first. Place the anterior portion of the coil on your patient, centered over their abdomen, and then secure the respiratory bellows tightly around the abdomen. Put the silver sleeves on both arms to prevent aliasing artifact. Place a cushion under the knees to relieve back pressure. Give your volunteer ear-plugs and squeeze ball and cover them with a blanket.

Check the respiratory waveform signal on the computer console screen. If it's clear and visible, you may proceed with alignment and landmarking. Landmark below the xiphoid at the rib cage margin.

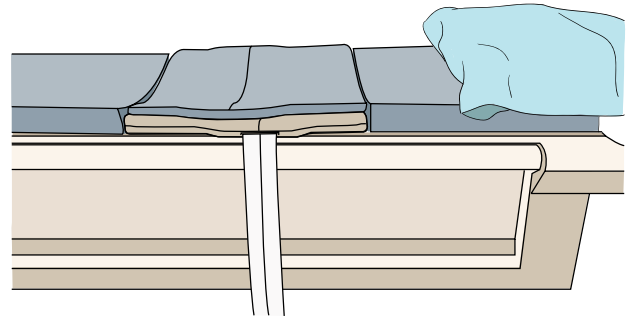


Fig 7.2 Positioning and placing the respiratory bellows

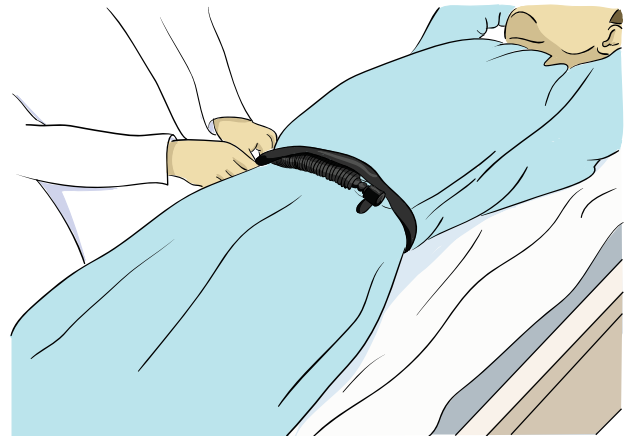


Fig 7.3 Placing the anterior cardiac coil

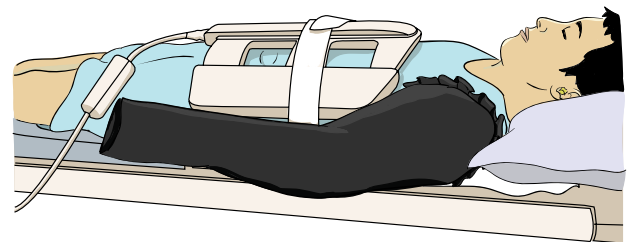
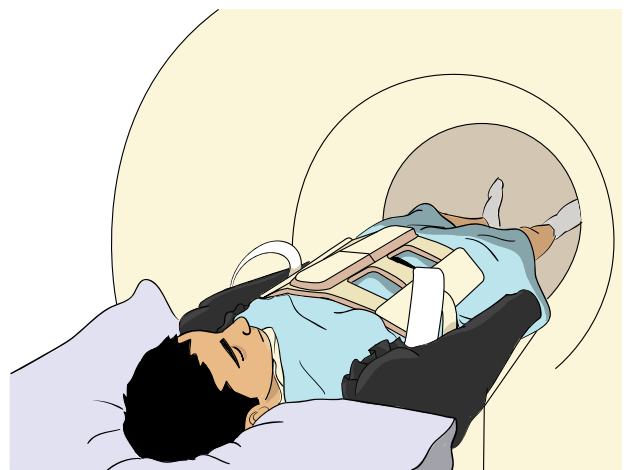


Fig 7.4 Landmarking



Step 4: Choose protocol

Choose Abdomen/lumbar as the site of the exam, select MRCP.PANCREAS on the Patient Protocol section, then click Accept.

Fill up the rest of the information needed on the Patient Position section. Be sure to select supine, feet first, and cardiac coil as the coil type.

Step 5: Three-Plane Localizer

Similar to the previous protocols, MRCP also starts with this sequence. Select 3-Plane from the Rx Manager, View Edit, Save series, Download, Prep Scan, give instructions for breath holding, then Scan.

Step 6: Calibration scan

This sequence is the same as the calibration scan we ran in the previous exercises. Just prescribe the scan and then move on

Step 7: Axial SSFSE with breathholding

Single Shot techniques use a single excitation pulse and each of the subsequent echoes is given a different phase encoding. In SSFSE, a single 90° excitation pulse is followed by sufficient 180° pulses and readouts. There are a number of sequence repetitions to acquire the raw data needed and each repetition then collects a fraction of the complete raw data set.

Acquisition of this series is fast, so patient cooperation increases. This particular sequence is used in cases where there is too much motion, such as the abdomen.

In this section, we will change the slice thickness and compare which slice shows the pancreatic duct clearly. It is important to choose the best slice thickness because two structures with different intensities contained within the slice will display a combination of the two intensities. On the other hand, if you use a thin slice or a slice with just the same thickness as the structure, only the signal intensity of the structure will be displayed.

Select AXL SSFSE THIN on the Rx Manager then click View Edit. Set the TE to 90 and change the slice thickness to 10, 7, 5, and 3mm respectively. Prescribe the Graphic Rx and adjust the Locs before Pause if needed. Click Save Series, Download, Prep Scan, give instructions for breath holding, then Scan.

Fig 7.5 Graphic Rx for Axial SSFSE

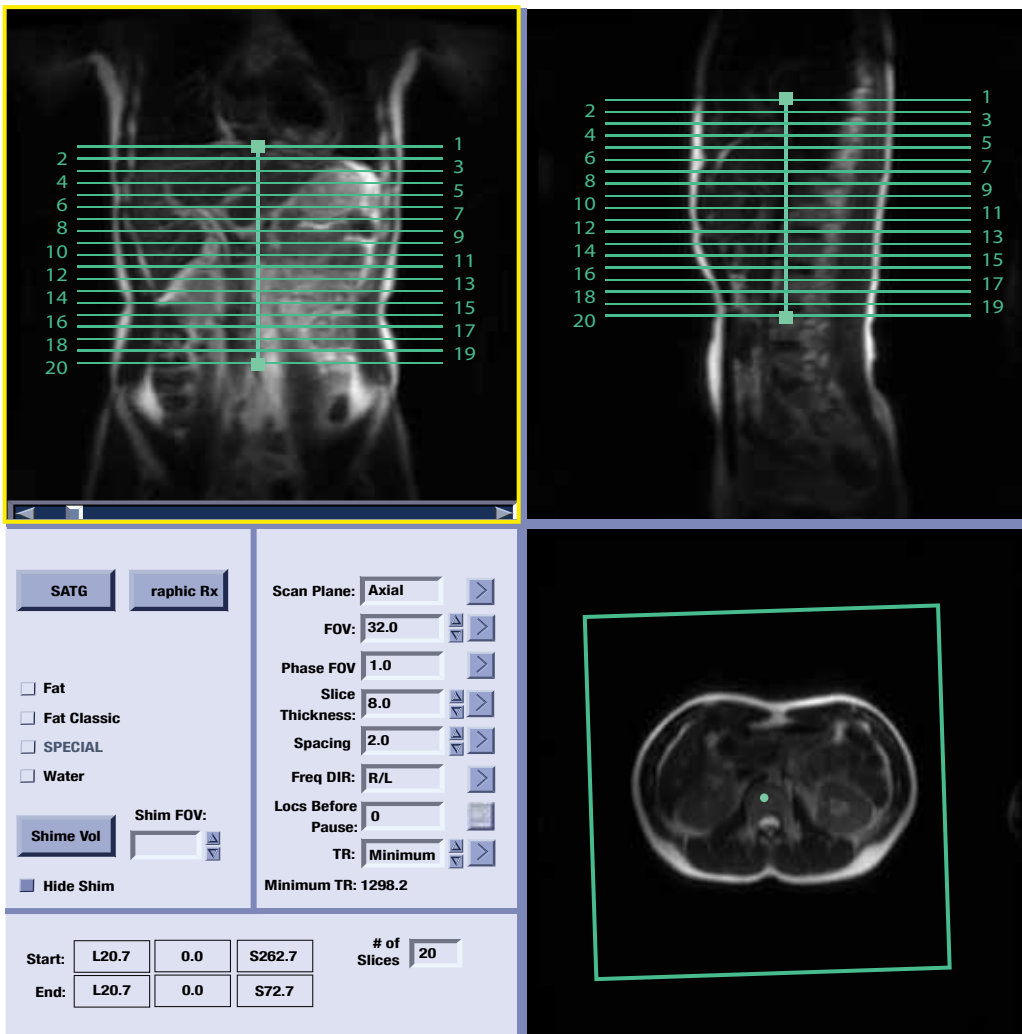
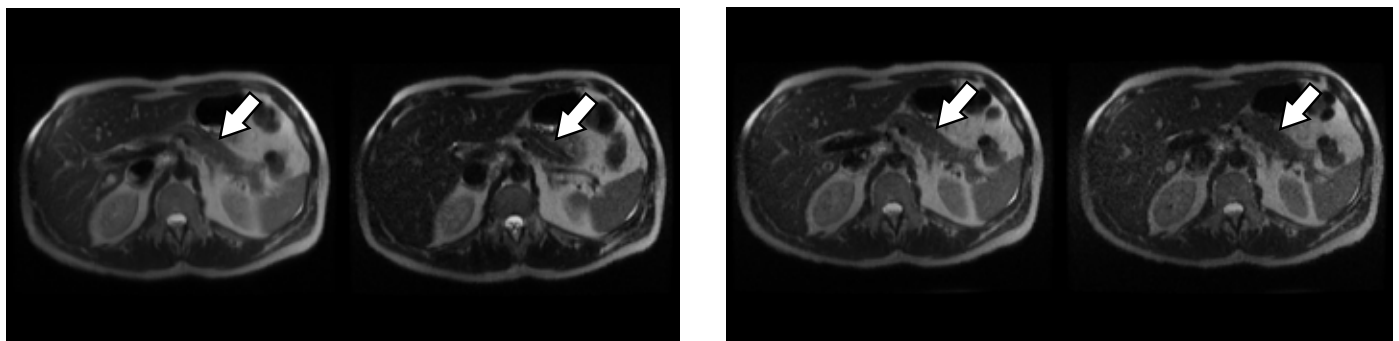


Fig 7.6 Pancreatic duct visualization for 10, 7, 5 and 3mm slices



(a) 10mm slice

(b) 7mm slice

(c) 5mm slice

(d) 3mm slice

Selecting the best slice just enough for the area being scanned prevents partial volume averaging effects. Partial volume averaging effect alters strength of response based on voxel size and size of responding region. There's a mixture of tissues within each voxel, where in fine details of structures cannot be resolved.

- a. 10mm – pancreatic duct cannot be visualized
- b. 7mm – pancreatic duct can be seen clearly
- c. 5mm – pancreatic duct seen but not as clear as 7mm
- d. 3mm – too noisy!

Step 8: 2D MRCP

MRCP is an imaging technique that aims to provide the information similar to an ERCP and other cholangiographic techniques with the use of heavily T2-weighted SSFSE images. Due to T2 weighting, fluid-filled structures are enhanced, while liver and other solid parenchyma are signal suppressed. The ductal anatomy can be seen clearly with a very high contrast as compared with the surrounding tissues. Thick slab acquires an image of the whole biliary system in 2 seconds with a single view and high in-plane resolution.

Select MRCP SSFSE THICK on the Rx Manager then click View Edit. Set the TR to 6000. Prescribe the Graphic Rx (Fig 7.7). Set the Number of Radial Slices to 10, Partial Radial Spacing to 15, and Radial Direction to CW. Adjust the Locs before Pause if needed. Click Save Series, Download, Prep Scan, give instructions for breath holding, then Scan.

Fig 7.7 Graphic Rx for MRCP SSFSE thick

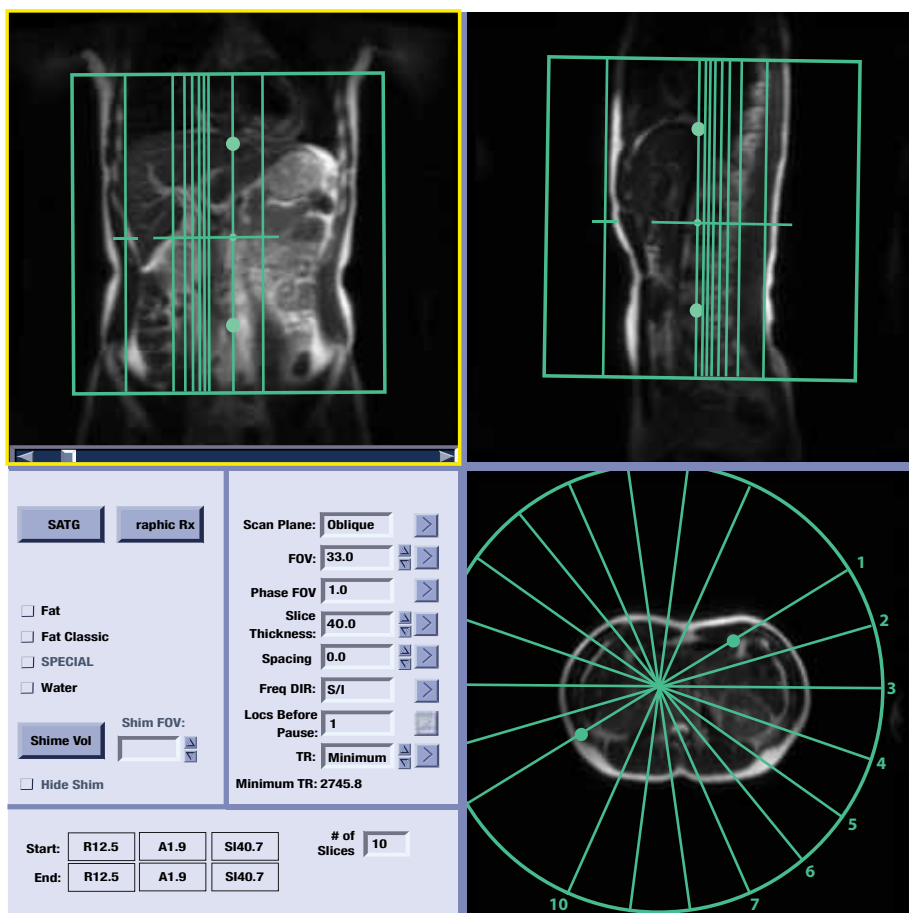
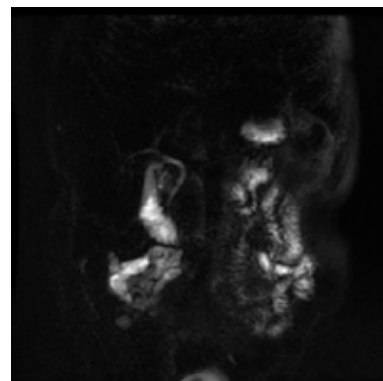


Fig 7.8 2D MRCP



Step 9: Coronal 3D MRCP with respiratory triggering

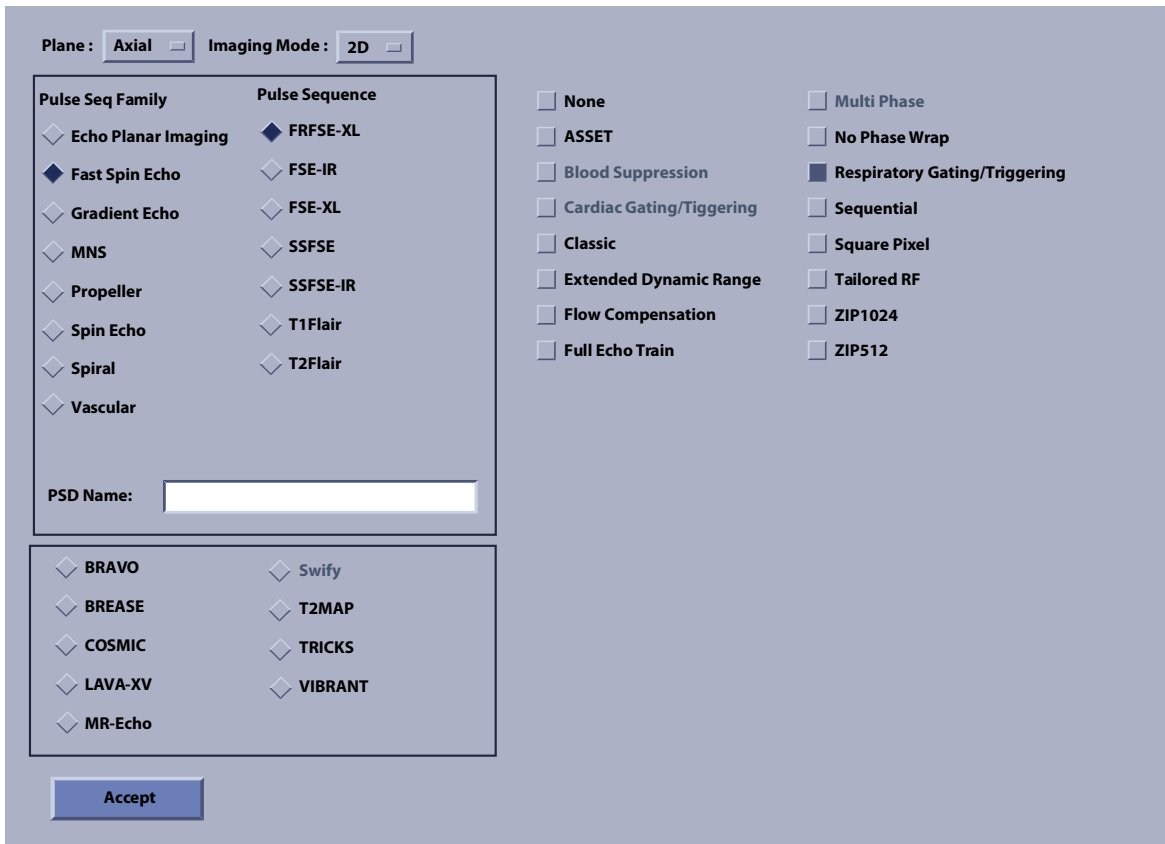
If a 3D acquisition is used, the acquisition time lengthens but the postprocessing function maximum intensity projection or MIP can allow reconstructions from the multiple slides.

To turn on the respiratory triggering, click the Imaging Options and select Respiratory Triggering on the pop-up screen then accept.

What is Respiratory triggering (Rtr)?

Respiratory triggering (Rtr) uses a closed bellows strapped around the patient's chest, which expands and contracts as the chest rises and falls. The system monitors the patient's breathing pattern and displays a "bar" beneath the waveform to indicate the scan's acquisition portion of the respiratory interval. It reduces respiratory artifacts by synchronizing image data collection with the respiratory cycle, acquiring images when the chest wall is in the same position.

Fig 7.9 Turning on the Respiratory Triggering



Select COR 3D MRCP RTr on the Rx Manager then click View Edit. Prescribe the Graphic Rx (Fig 7.9). Click Save Series, Download, Prep Scan, then Scan.

Fig 7.10 Graphic Rx for MRCP SSFSE thick

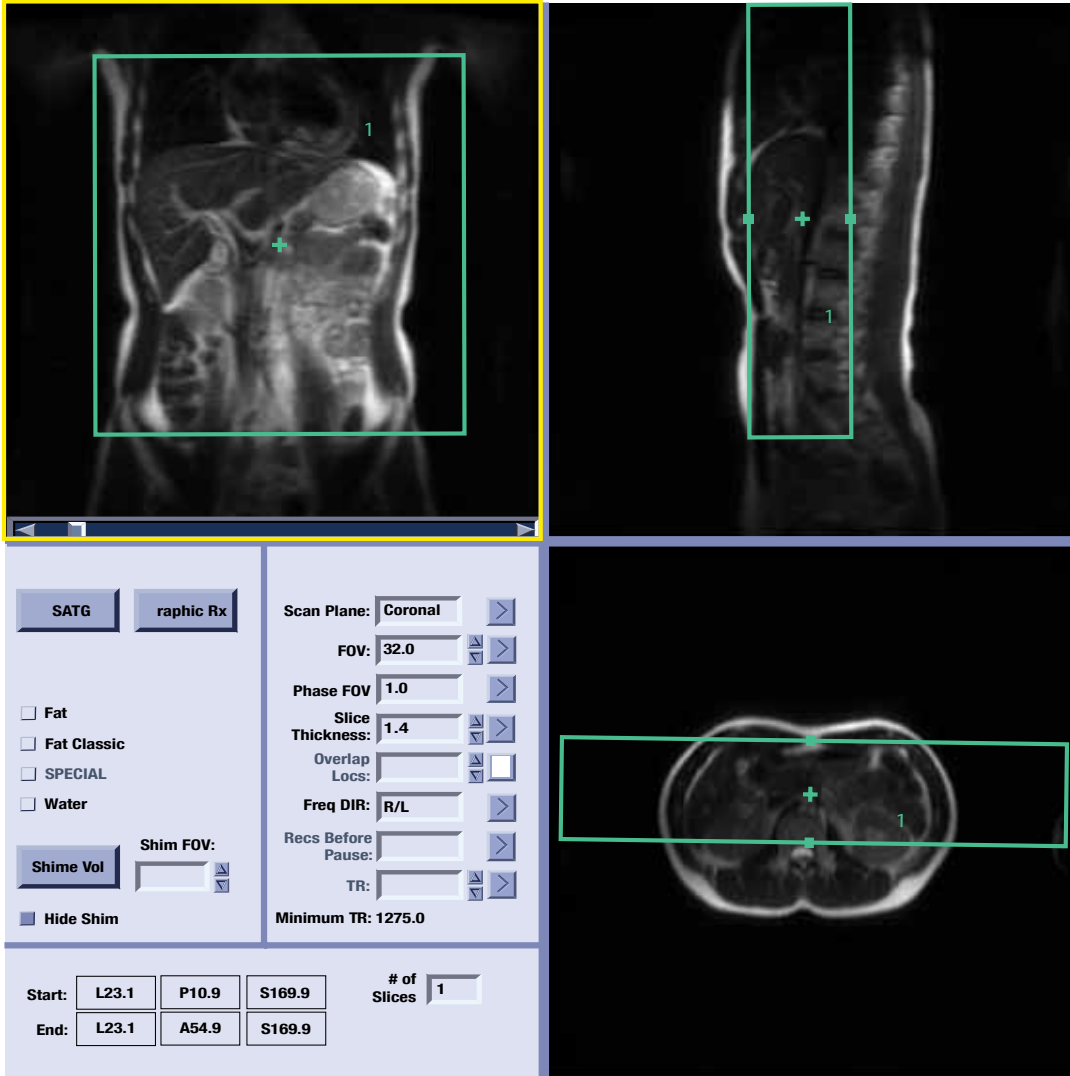
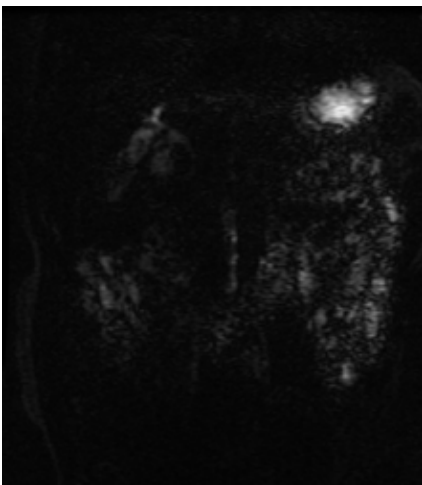


Fig 7.11 Cor 3D MRCP with respiratory triggering



Step 10: Clean up

Return room to its neat state.