Long Bone Imaging Proximal Lower Limbs utilizing Tim Technology and the Tim User Interface

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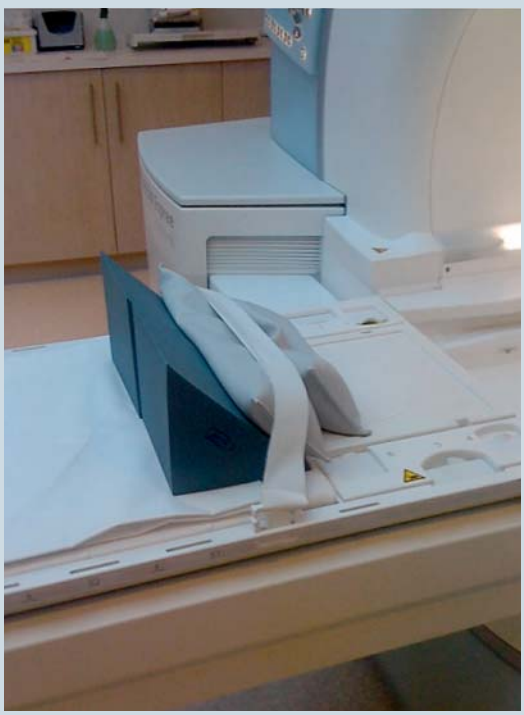
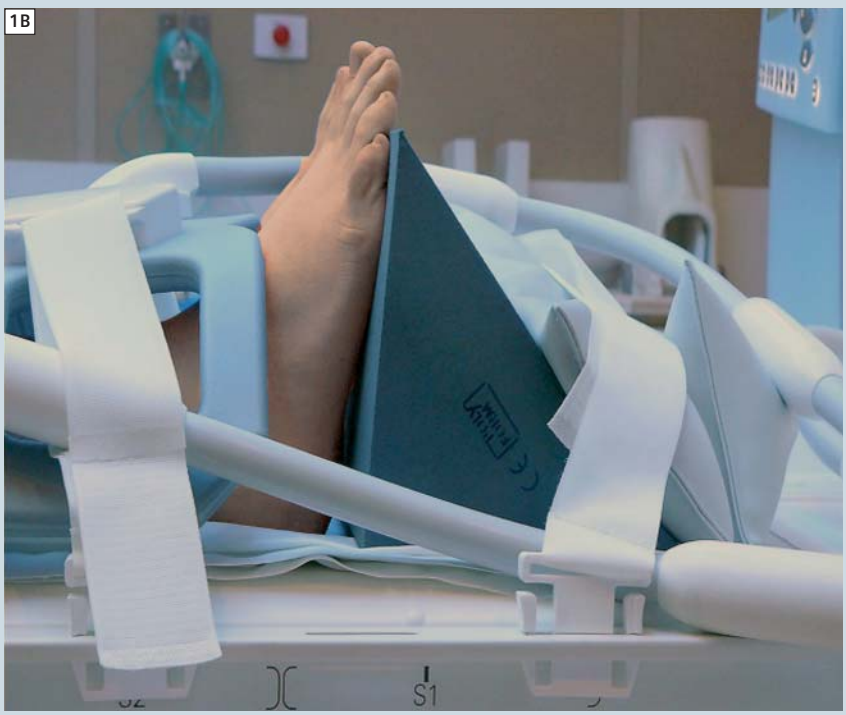
Proximal Lower Limbs with Tim

Positioning technique

- Head coil and C-spine coil removed from table.
- Spine coil on the table and plugged in.
- Create a bolster for the patients' feet using two triangular pads and sandbags to support them as shown in the images. This support should be placed as close to the opening of the bore as strapping will allow. This support helps the patient keep their legs still.
- Position the patient on the examination table feet first with their feet dorsiflexed and placed on the support pads.
- Ensure the patient is in the middle of the table and that their legs are as close together as possible.
- Place the two Body matrix coils over the patient's upper limbs strap down and plug in. Start from the patella apex as a guide.
- Use the laser to centre to the patients symphysis.
- Press the isocentre button to move the patient in to the magnet bore.

Set up the triangular sponges as shown in these images. You can move this support even closer to the bore than in this image as you can see there is still one more distal strapping point. This allows you to position the patient comfortably with a high degree of immobilisation.






1C

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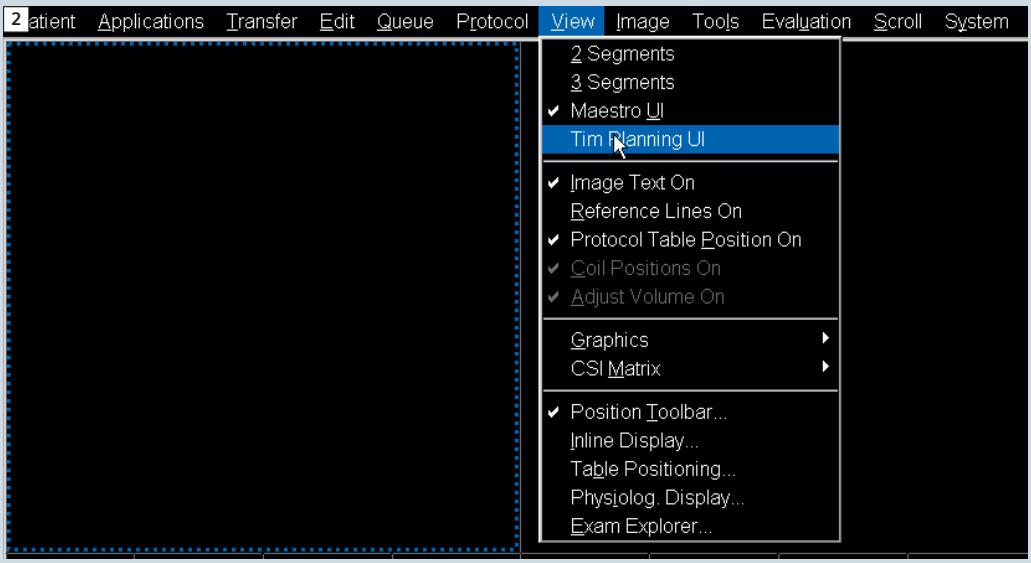
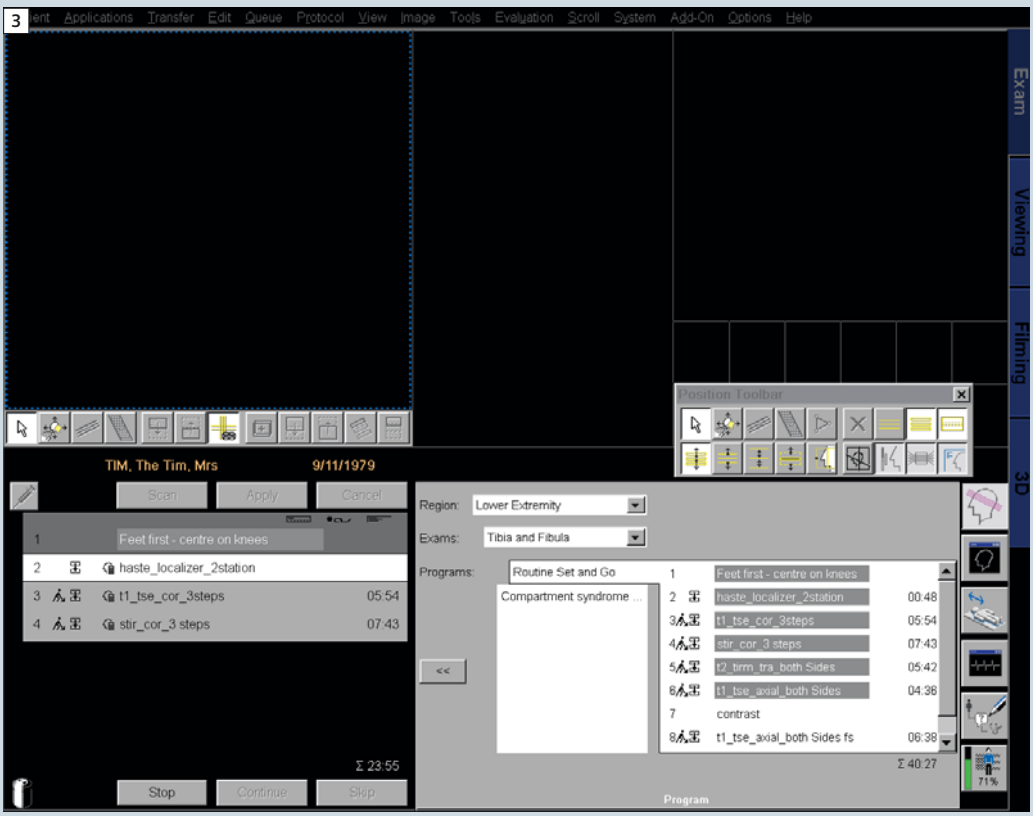
Tim planning

- When running a lower limb protocol it is useful to activate the Tim Planning Suite user interface.
- Figure 3 demonstrates the layout of the Tim User Interface. At our institution the protocol for lower limb MRI is saved under the MSK protocols within the Lower Extremity subsection. Generally for the proximal lower limb you will either be looking at the hamstrings or the femur and surrounding soft tissues.





Running the localizers

- First step to planning is to run the localizers. Drag the appropriate HASTE localizer into the queue for running. You can bring the other sequences you will run over at the same time. This localizer begins running from the symphysis down to mid femur then moves the table before running localizers from the mid femur down to the knee. We end up with two localizers in the running queue and thus a two station localizer. Once complete these two stations are automatically composed Inline into one complete image for the entire proximal lower limbs in both sagittal and coronal planes. These images allow us to plan the setup for the rest of the scans.

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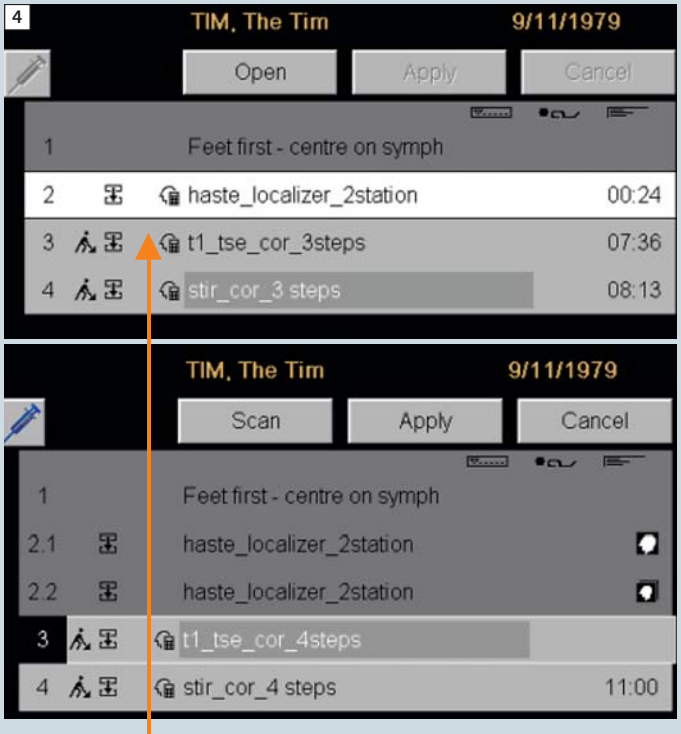

In this example localizer the patient has very long femurs. As such the Technologist has switched from a 3 step protocol to a four step protocol.

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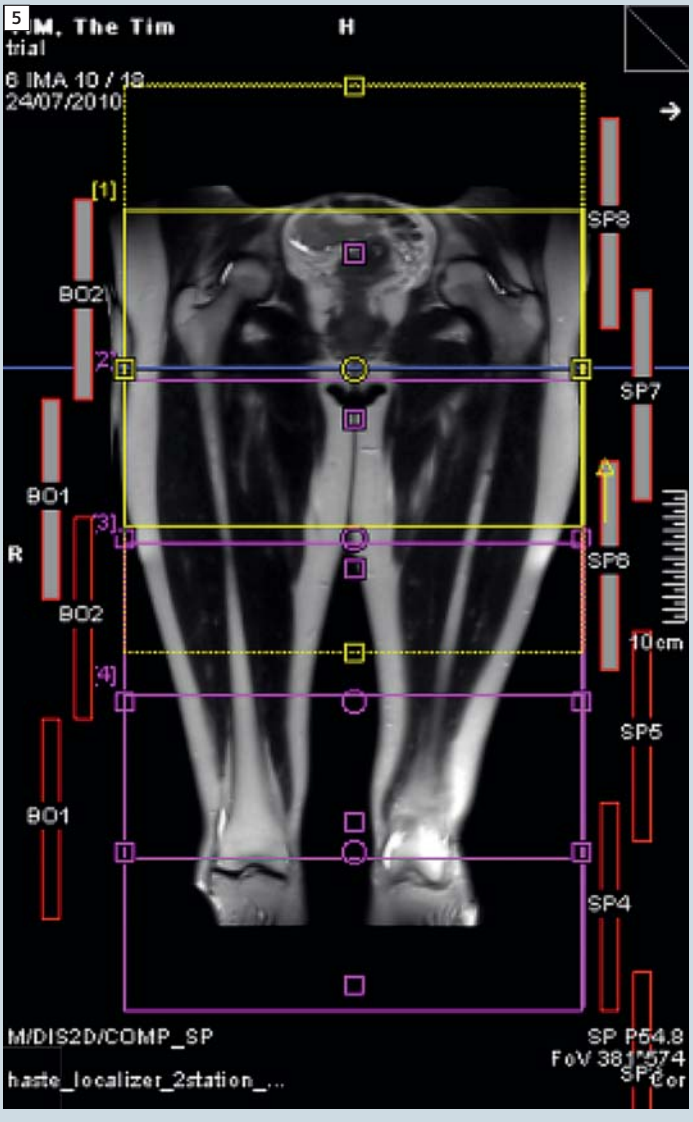
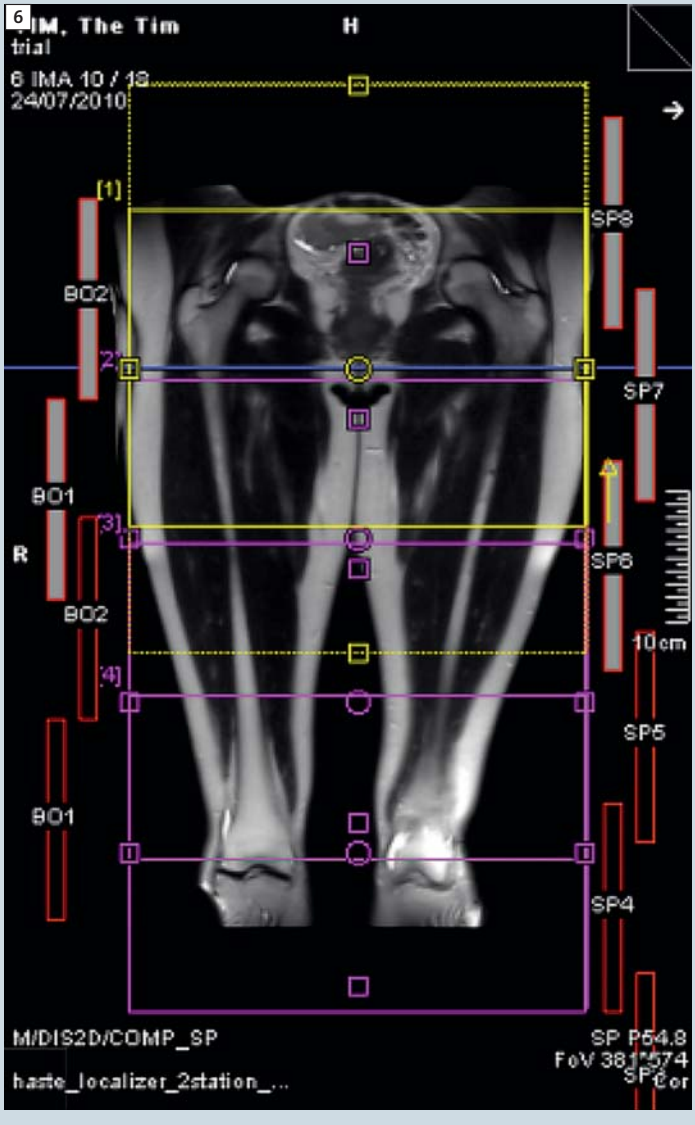


Coronal acquisitions

Setting up the correct fields-of-view

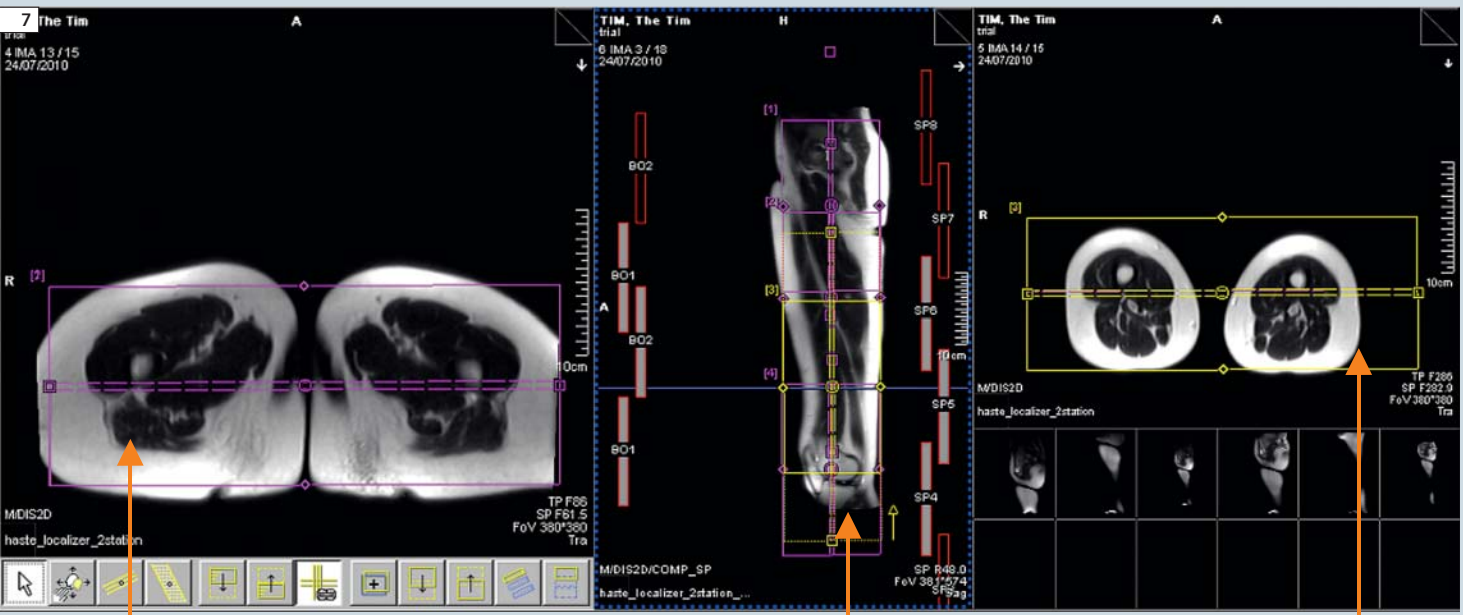
- Drag the T1 coronal sequences across into the queue and open it. The default is a 3 step protocol. This sequence displays three separate sub-protocols. This ensures we have maximum coverage with minimal distortion. If upon opening this sequence it becomes obvious that you will not have enough coverage then there is also a four station sub protocol available. Some people have very long legs!
- When setting up for any long bones it is best to take a systematic approach.
- Initially set up your FOV to ensure that you are going to cover the entire region. This involves placing a composed coronal image of the lower limbs into the middle rectangular window.
- When setting up your FOV coverage ensure **coupled graphics is on**. This can be achieved by right clicking in any of the three boxes and selecting the option.
- With coupled graphics on you can then move your FOV and position it appropriately for the correct coverage (Fig. 6).



Note the four separate FOV boxes. The upper FOV is yellow and this indicates that it is currently active. By utilizing coupled graphics you can grab and drag all of four and move them as one. This makes setting up your coverage very easy. Each FOV is also numbered and you can select them by clicking on the little numbers.

Setting up the slice positions

- Once the FOV has been set you need to set the slice group locations for each of the subgroups.
- The best way to do this is to load your individual axial station localizers into the two square windows. This helps you to visualise your coronal slices.
- In the rectangular window place a composed sagittal image. This gives you an indication of the relationship between each subgroup of slices.
- Unlike the spinal cord almost all patients' long bones are relatively straight. This makes setting the slice positions easy. You can leave coupled graphics on and move the slices as one. The protocol is set up with plenty of slices to allow easy complete coverage in the coronal plane.



By having an axial localizer of the proximal femur in this box you can keep an eye on your slice coverage for the proximal portion of the lower legs. This sub-protocol is not rotated about the H–F axis which is ideal. However if this needs to be done do so with **coupled graphics on** so all sub-protocols match. Otherwise composition will fail (see important notes).

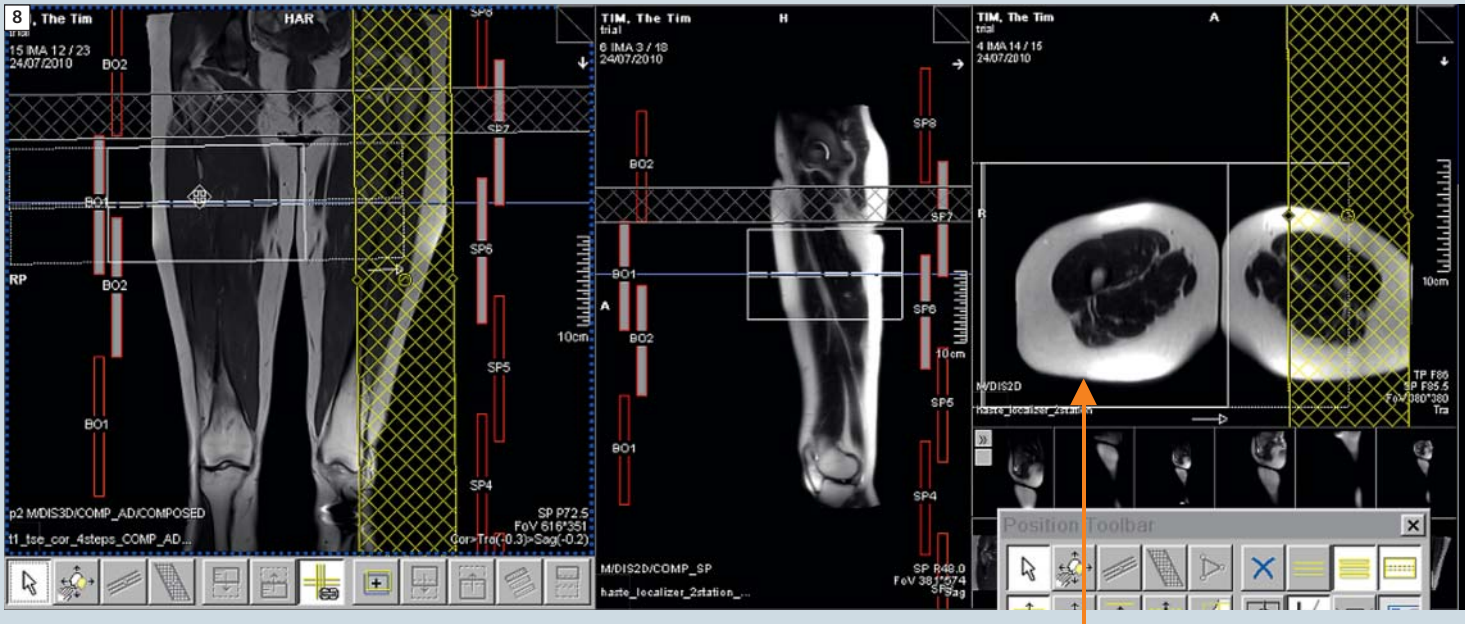
A composed sagittal gives you an indication of both the position of your subgroup slice positions and also a good overview of your total FOV.

By having an axial localiser of the distal femur in this box you can keep an eye on your slice coverage for the distal portion of the lower legs. This sub-protocol is not rotated about the H–F axis which is ideal. However if this needs to be done do so with **coupled graphics on** so all sub-protocols match otherwise composition will fail (see important notes).

Axial acquisitions

Setting up the correct fields-of-view

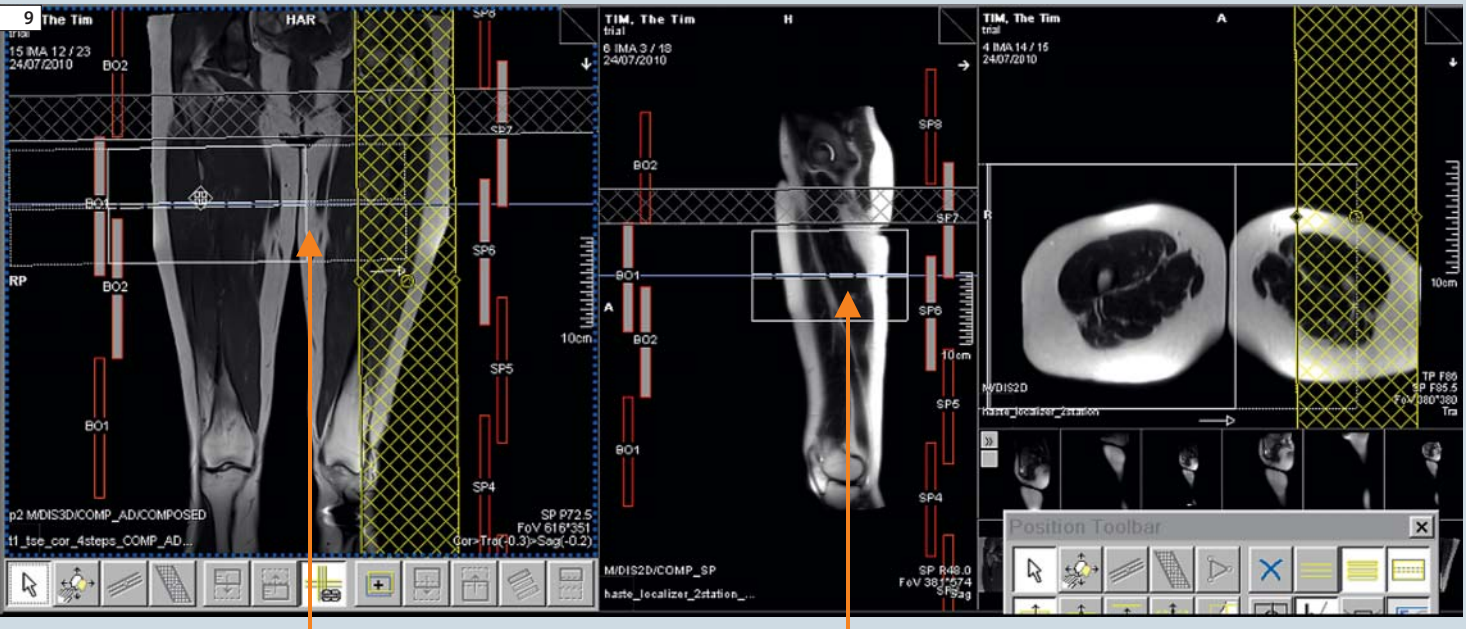
- Drag the T1 axial sequence across into the queue and open it. This is a single slice group.
- To allow for the correct FOV you can place a coronal, sagittal and axial set of images in each window. This makes it easy to ensure your anatomy is in the middle of the FOV and that you will not cut off anatomical regions as your slices progress down the leg.



The proximal axial localizer allows you to position your FOV to ensure you cover all of the proximal portion assuming of course that the region of interest lies in this region.

Setting up the slice positions

- Once the FOV has been set you need to set the slice group locations for your axials.
- Making use of the three windows place coronal sagittal and axial slice groups into each. You can then easily identify the relevant region of interest and ensure your slice groups are running through that region. If there is concern over coverage consider turning the single slice group into a multi-step protocol by adding a sub-protocol from the Tim planning suite toolbar.
- Depending on your choice of axials if you need to cover a large region then you will be using a multi group sequence. In this case when setting up do so with **coupled graphics on** as the two slice groups are linked and this ensures a contiguous run of axial slices.



Coronal and sagittal slices make it very easy to identify the region your slices should cover in the axial plane.

Important notes

- Any presets that you position will affect all three subgroups. As such if you use presets you must pay attention to their positioning.
- Changes made to one subgroup will not affect the other groups so never assume!
- Pay attention to the position of the patient on the table, they need to be close to the middle otherwise you are likely to encounter artefacts on your coronal images.
- Overlaps are built into the protocols, be careful when setting up your FOV. Keep these overlaps in place to ensure smooth composing of final images. Thus when setting up your FOV leave coupled graphics on.
- Avoid in-plane rotation when planning your sequences as this will affect the composing of the final images.
- For coronal and sagittal sequences you may angle your sub-protocols in either the A–P (coronal) or R–L (sagittal) planes when using these 2D protocols. However be aware of the previous point. Thus if setting up a coronal sequence you could angle in the sagittal plane to acquire well placed slices but obviously you need to avoid rotation in the coronal plane as this would correspond to in-plane rotation.
- Rotation of sub-protocols in the F–H (axial) plane should be avoided unless absolutely needed. A difference of just 1 degree between sub-protocols will cause composing to fail. If you do rotate in this plane make sure **coupled graphics is on** as this will ensure any changes you make in this plane apply to all sub-protocols.
- The axial sequences have been optimised to ensure the maximum coverage with minimal distortion. If you need more coverage consider adding a subgroup rather than increasing the number of slices.
- If you need to repeat a subgroup due to patient movement then you only need select the region affected by the movement and rerun that particular subgroup. See the example in figure 10.

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You can see how each subgroup for the T1 coronals has its own number 3.1, 3.2, 3.3 etc. Thus if you need to rerun a region simply hold shift and click the one you need to repeat. Drag and drop that region back into the queue. A cross will run through the compose indicator, this shows that it is only going to run that one region again.

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