

The Composer

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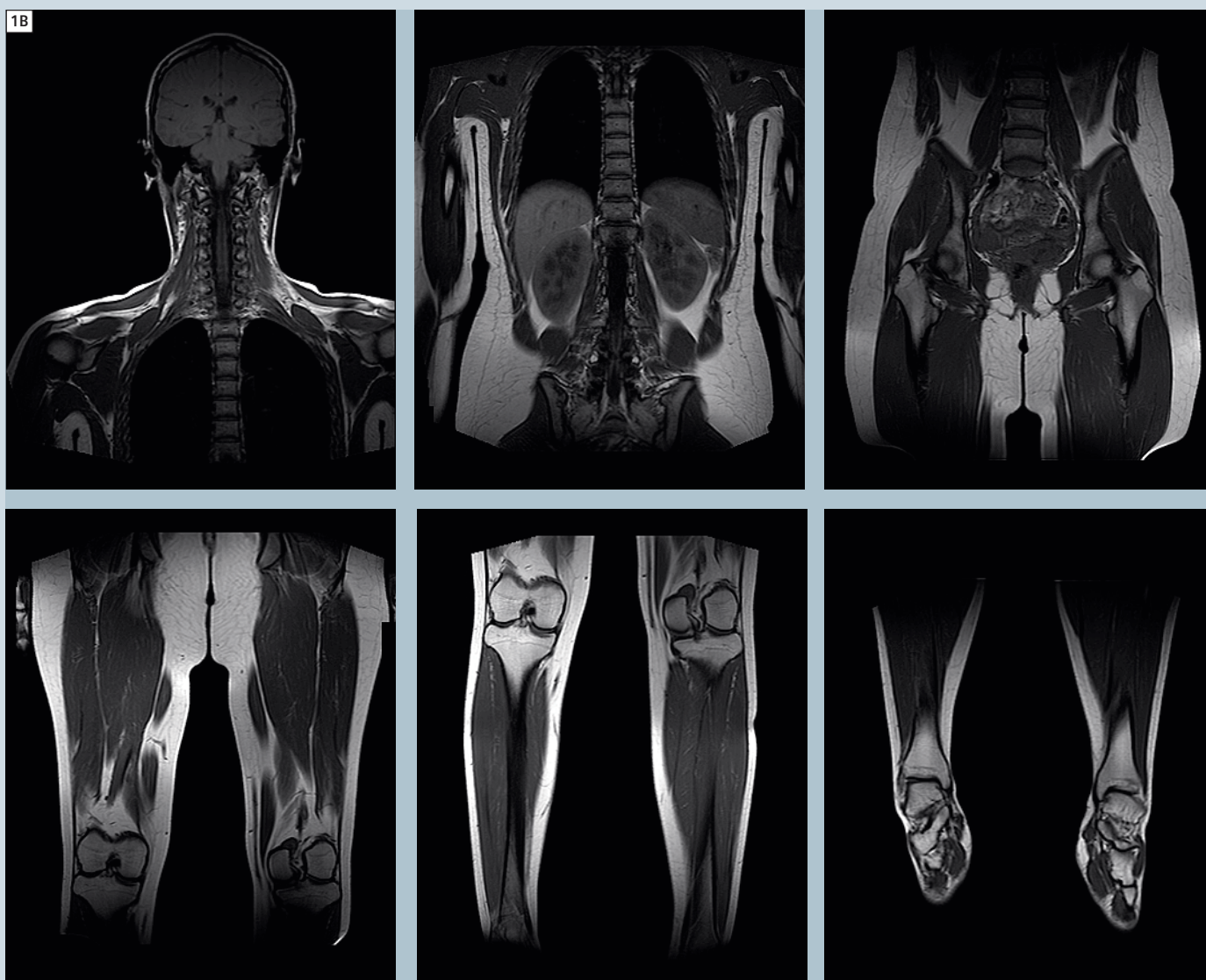
The composing software is an image stitching program similar to stitching scenic photographs into a panoramic picture. The difference with the composer is that it stitches the image in the vertical direction. The reason we do this is that our MR systems have a maximum field-of-view (FOV) of 35–50 cm. The human anatomy is often larger than this, and by composing the images we can achieve an effective FOV of up to 205 cm. The software is able to compose multiple slices for example; eleven sagittal slices from the upper and lower spine can be composed to create a composite image of eleven sagittal slices of the whole spine. Multiple data sets can be composed to create whole body images (Fig. 1A and B), or simply two regions for a smaller area of interest (Fig. 1C). Whilst most radiologists are used to and prefer the original smaller data sets to report from, clinicians and patients benefit from the composed images by having a better perspective of lesions and their location in relation to the rest of the body. The simplest and most useful function of the composing software is composing localiser scans especially with the use of the Inline Composing. Workflow is optimised by scout images being automatically composed and loaded into the exam card for subsequent planning of images.

Most parts of the anatomy can be composed using the spine algorithm, which is based on bone structure but not limited to just the spine. Similarly, vascular studies can be composed using the angio algorithm.



1 (A) is a composed whole-body MR image that consists of six different data sets, each covering a different anatomical area as shown in (B). The syngo composing software can also be used for image integration from all types of multi-step MR examinations as demonstrated in (C).





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Once images are composed the software will advise if there has been any mismatch between data sets. Any inadequate matches are indicated by red triangles at the mismatch points. If necessary, the images can be adjusted up / down, right / left, or front / back. A normalise filter will even out any signal intensity variations between the different data sets. (Visit www.siemens.com/magnetom-world for the technical aspects of the normalise filter: "Image Quality Improvement of Composed MR Images by Applying a Modified Homomorphic Filter" by V. Jellus et al.)

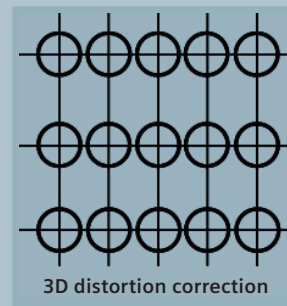
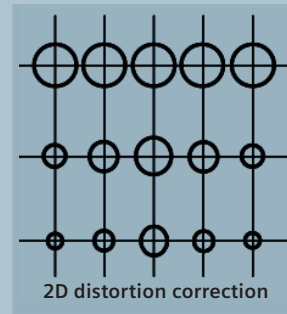
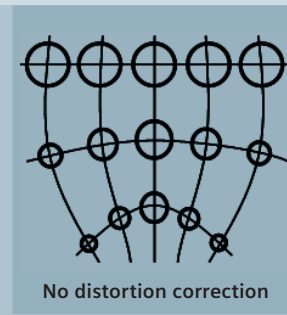
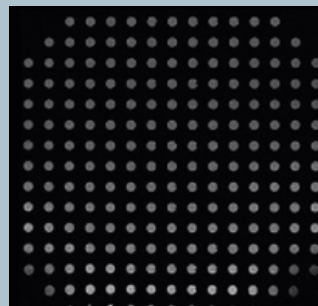
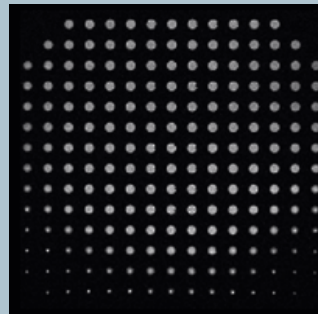
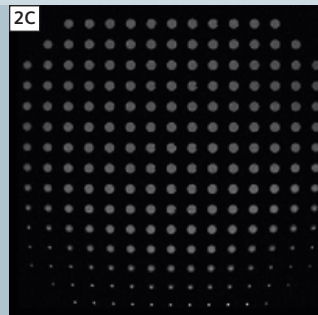
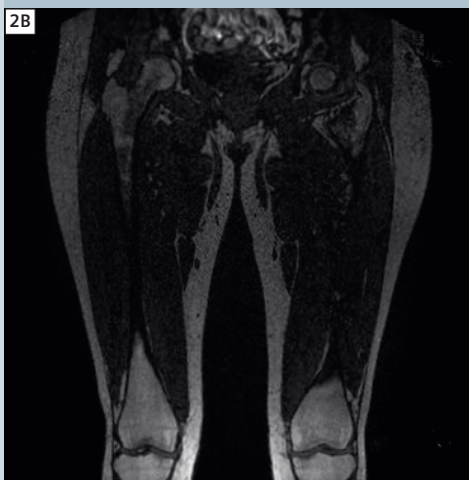
Certain criteria are required for the software to be able to compose the images:

1. Must come from the same frame of reference.
2. Must be distortion corrected.
3. Must be the same image type.
4. Cannot be rotated about the feet-head (FH) axis.
5. Can angle by 45° in the other axes.
6. Can have different matrix size, FOV, slice thickness or number of slices between data sets.

Frame of reference

To ensure that the series come from the same frame of reference, they need to be distortion corrected.

Once distortion correction has been applied, the images belong to the whole body coordinate system and have the same frame of reference.



2 Figure 2A demonstrates the influence of geometric distortion on large field-of-view MR images, especially present at the edges of the field-of-view. (B) shows the same image corrected by a distortion algorithm. The positive influence on the overall image quality is clearly visible. Distortion correction can be applied either as 2D or 3D algorithm; the influence on image information by a distortion correction is given in (C).

Distortion correction

Images acquired on a large FOV will suffer from geometric distortion at the edges of the FOV (Fig. 2A). This is due to non-linearity over the length of the gradients. Geometric distortion can be corrected by applying either a 2D or 3D distortion correction filter (Fig. 2B). The advantage of the 3D distortion correction filter is the additional corrections in the through-plane direction (Fig. 2C).

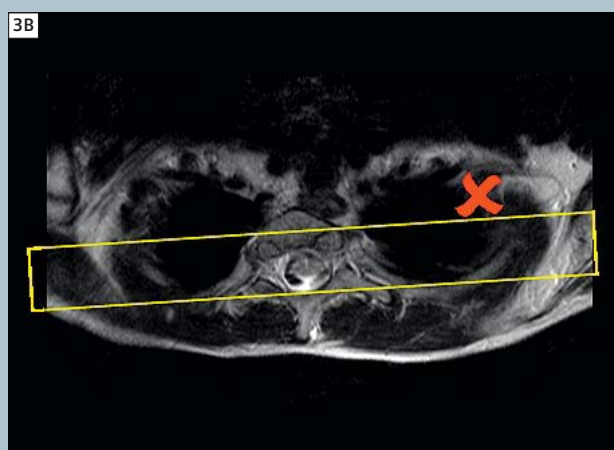
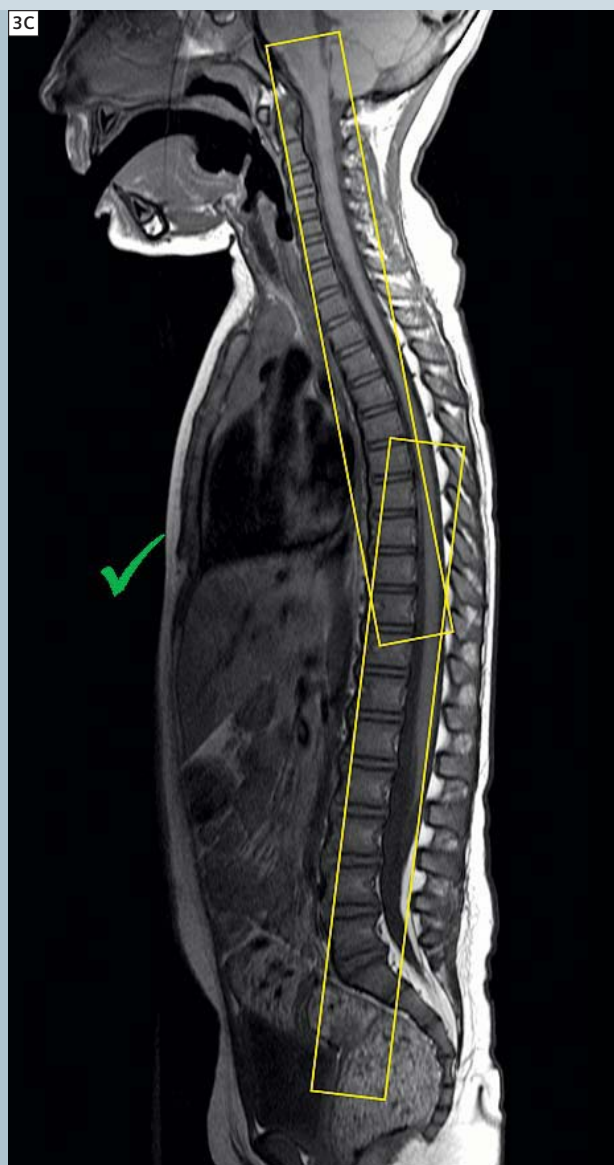
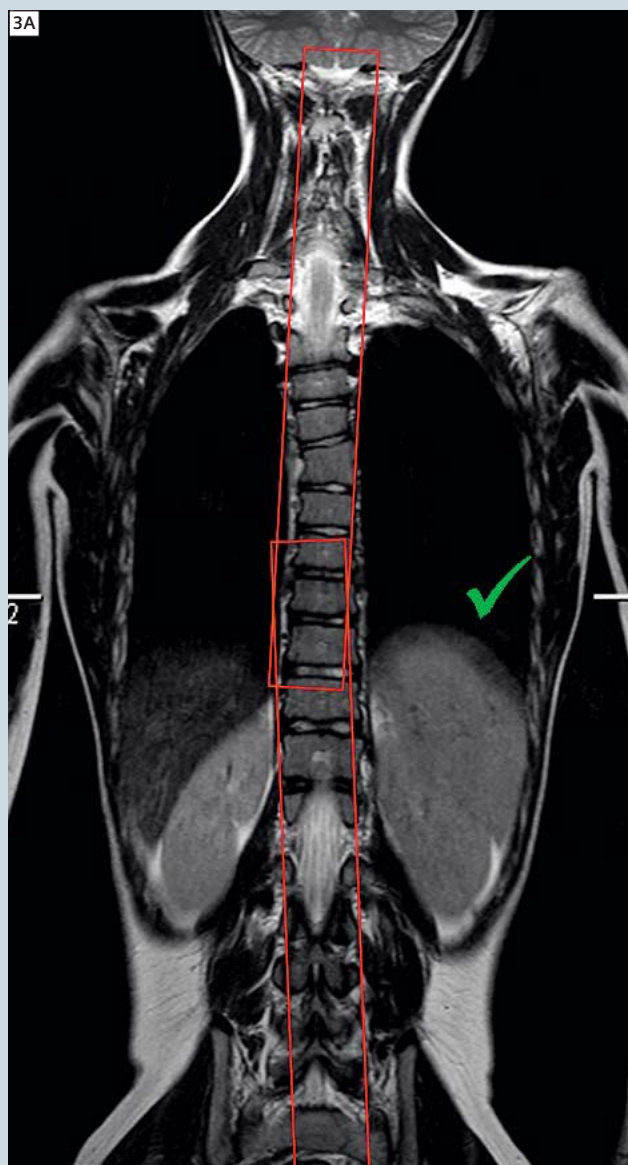
Same sequence type

This requires the data to have been acquired by the same technique. It is not possible to compose gradient echo sequences with spin echo, or 2D sequences with 3D.

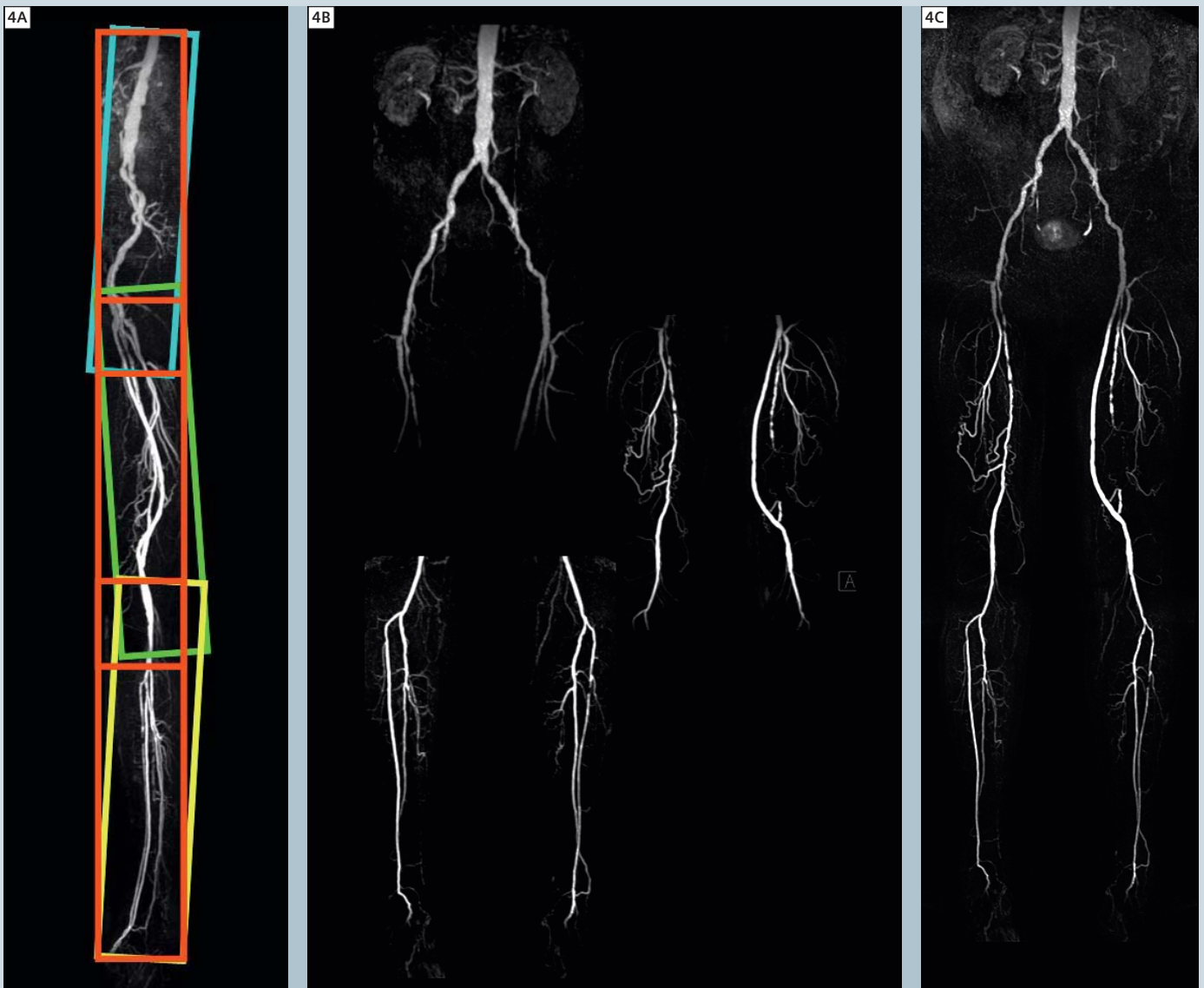
Planning the scan

When planning sagittal or coronal images, it is important not to rotate about the feet-head axis (Fig. 3B).

If scans are rotated in this direction, the subsequent regions must be of the same angle. A difference of more than one degree will render the data sets unable to be composed. Angulations of up to 45 degrees in the other planes are acceptable for 2D sequences (Fig. 3 A and C), but with steeper angulations a limited number of composed images may result.



3 Planning the scan.



4 A composed 3D multi-step MR examination. (A) shows the regions of interest (B) their relative angulations. The resulting image provides a fast overview of the vessels (C).

Be careful when planning 3D data sets as there is less leeway between angulations. While 3D data sets angled more than six degrees will compose, they may not be able to be used in any subsequent post processing such as MultiPlanar Reconstructions (MPR) or Maximum Intensity Projections (MIP). A warning will appear on screen that the images will be saved as secondary capture images. To avoid this, it is recommended to plan the sequences as straight as possible to ensure the

regions will compose (Fig. 4A). This may require additional slices to include the required anatomy, but in vascular studies slice increases should not be to the detriment of accurate contrast timing (Fig. 4 B and C). Composing is a useful and rewarding post processing step applicable in almost any two or more region scans. With the use of Inline composing, original data sets can be automatically composed and saved to the database at the end of the last sequence acquisition.

Contact

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