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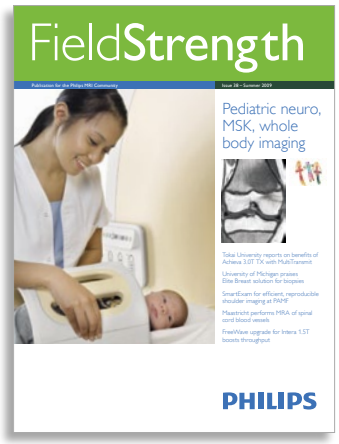
Acetabular radial hip imaging



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Acetabular radial hip imaging

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MR hip imaging is routinely performed for assessment of the acetabulum and acetabular labrum. These scans are traditionally acquired in the orthogonally planned axial, coronal and sagittal planes. The results of these scans demonstrate true parallel slices of the acetabulum, acetabular labrum, femoral head and neck, and trochanter anatomies. An additional view can be acquired using radially planned slices for a unique anatomical perspective.

MR imaging of the entire acetabular labrum is difficult due to its complicated location and because it is easily affected by partial volume effects[1]. A radial scan acquires slices, centered on a planned radial axis, providing full visualization of the entire acetabular circumference. Orthogonally planned slices compromise this circumference which may cause a partial volume of the anatomy. Radial imaging has been described as more accurate for the diagnosis of acetabular labral lesions, when compared with oblique coronal and oblique axial slices[2].

Tip 1: Patient set-up

Patient positioning is easily achieved with the patient either head-first or feet-first on the table. Often this choice is based on the comfort of the patient with receiving an MR scan.

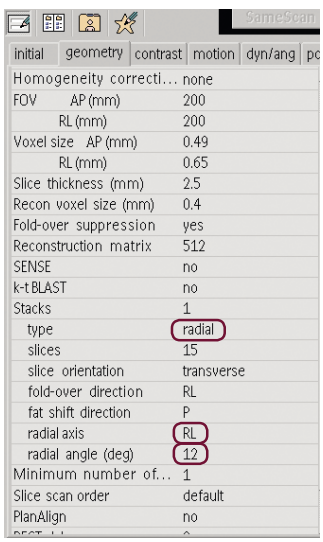
There are several options for the coil to use. The actual choice depends largely on availability at the site. Turn the patient's feet inward to pronate the greater trochanters, and support in position with velcro straps wrapped around the feet. Place a sponge in between the ankles to maintain the inward position of feet and toes.

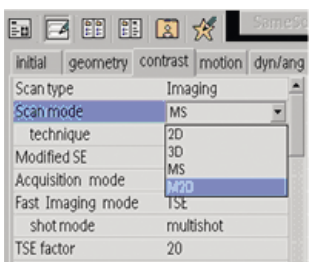
Tip 2: Radial protocols

In radial protocol planning a radial axis (e.g. right to left) and a radial angle are specified within the protocol. This type of scan could be thought of in terms of a bike wheel, where the axle of the wheel is the radial axis, and the slices are the spokes of the wheel.

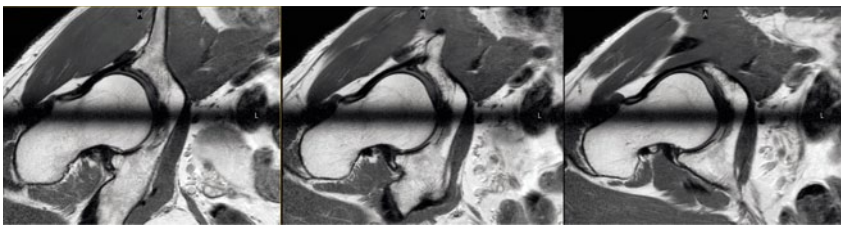
The scan type, radial axis and slice orientation parameters are selected under the Geometry tab, in addition to the number of slices and radial angle.

The number of slices chosen will limit the maximum radial angle possible, and also impact the scan time.





A radial scan may be either a multislice (MS) sequence, or a multiple single slice (M2D) sequence. This is specified by the Scan mode parameter under the Contrast tab.



Scan mode MS

Scan mode M2D

The benefits of a MS radial scan include shorter scan times – which will permit a higher resolution matrix to be scanned – at the cost of a crosstalk artifact that follows in line with the radial axis. If only the acetabular labrum is evaluated, this crosstalk will not interfere with visualizing the anatomy.

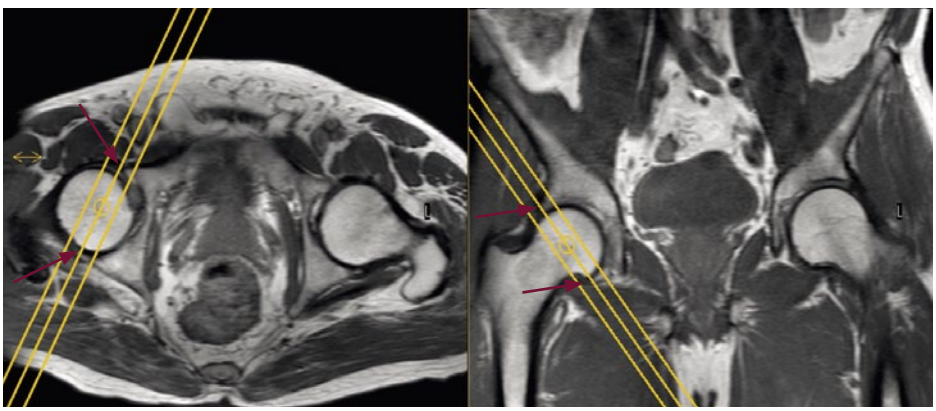
The M2D sequence will avoid this crosstalk artifact across the joint, if visualization of the entire acetabulum circumference is needed. However, scan time will be longer, which may require lowering the matrix or reducing the number of slices. Another option to avoid crosstalk would be to use a gradient echo acquisition.

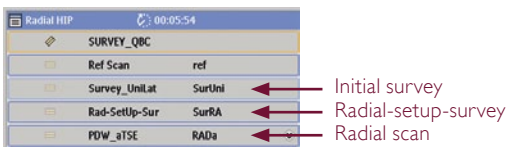
Tip 3: Planning the radial scan

Planning of the radial scans requires several surveys to correct for the complex anatomical angulations of the acetabulum and provide geometric offsets and angulations for the sequences[3]. These offsets and angulations are carried over into the radial sequence in such a fashion that the radial axis is perpendicular to the acetabulum. This planning results in a series of images demonstrating the femoral head, acetabular labrum and acetabulum at incremental angulations. There are several methods of planning a radial scan, but the preferred method makes use of two initial surveys and a radial-setup-survey, as shown below.

First, two initial surveys are acquired that should be of such quality that the anatomical detail is clearly demonstrated. These surveys are orthogonal true axial and coronal slices, and may be combined into a multi-stack sequence.

Use the axial and coronal slice that best demonstrates the mid-point of the acetabulum to plan a radial-setup-survey with double angulations, see figure. The red arrows indicate the acetabular points for aligning the radial-setup-survey.

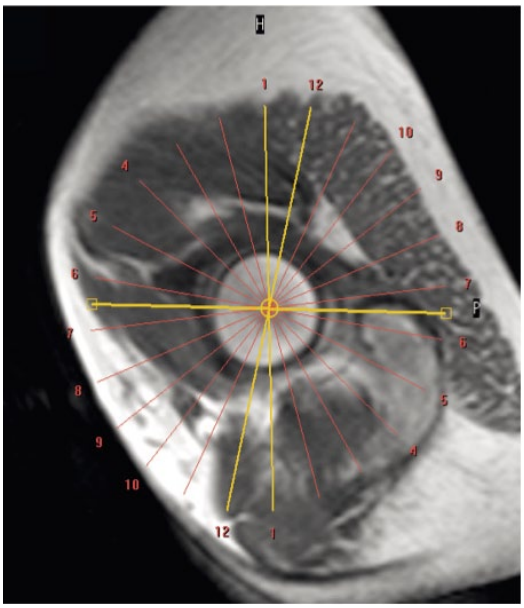




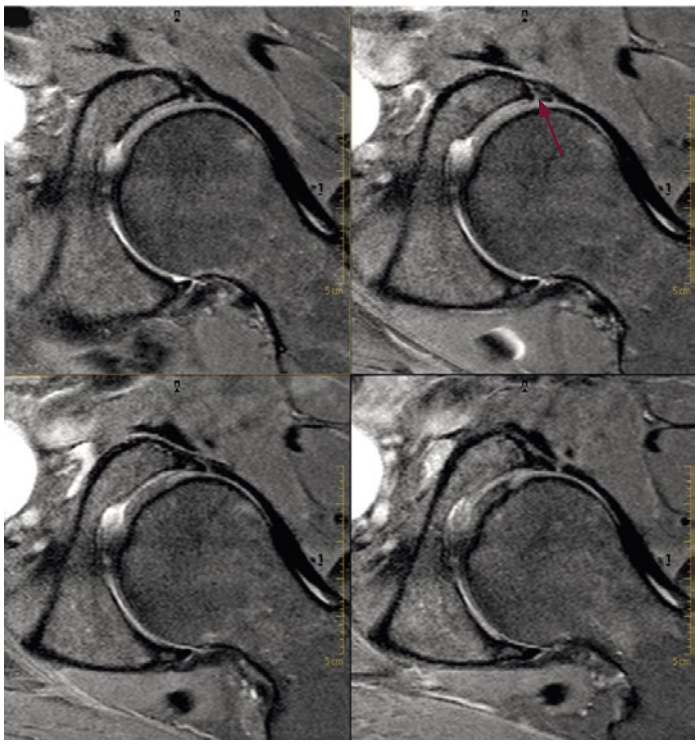
Example of radial ExamCard.
Note the unique GEO names.

The radial-setup-survey provides a double angulated view of the femoral head and contains all angulations needed for the radial scan.

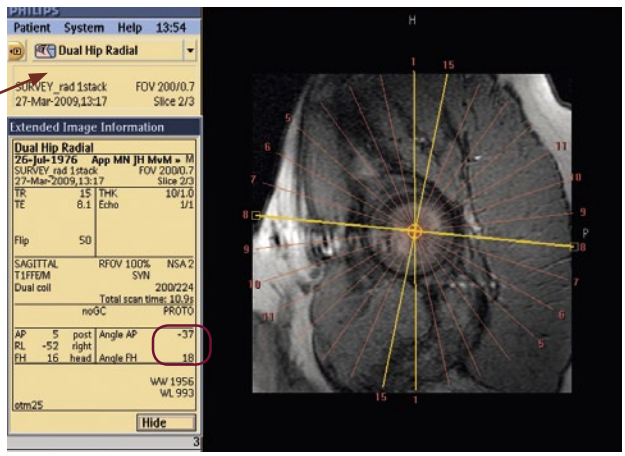
The radial slices are centered on the femoral head, with slice 1 in the coronal or 12 o'clock position, and the following slices rotated incrementally.



The radial PD TSE SPAIR images demonstrate the acetabular labrum with the neck of the femur in varying degrees around the acetabulum. Note the labral tear (arrow).



Tip 4: Transferring the correct angulations to the radial scan



Although using the GEO name of the radial-setup-survey would transport the correct angulations to the radial scan, it would also reset the radial scan back to a parallel acquisition. To prevent this, load the radial-setup-survey in a viewport and click on it, so it highlights with an orange border. Click on the orange info box (red arrow) to extend the information.

initial	geometry	contrast	motion	dyn/ang	postproc	offc/ang
Stacks		1				Total scan dura
Stack Offc. AP (P=+mm)		0				Rel. signal level
RL (L=+mm)		-56				Act. TR/TE (ms)
FH (H=+mm)		17				ACQ matrix M x
Ang. AP (deg)		**-37** (-31.27)				ACQ voxel MPS
RL (deg)		**0** (0.23)				REC voxel MPS
FH (deg)		**18** (12.95)				Scan percentag

Now open the radial scan and type in these exact angulations.

Stacks	1
type	radial
slices	15
slice orientation	**transverse** (sagi...
fold-over direction	AP
fat shift direction	**L** (F)
radial axis	**RL** (AP)
radial angle (deg)	12

If the planned radial scan does not resemble the spokes on a wheel, similar to the figure, then change the orientation and/or the radial axis.

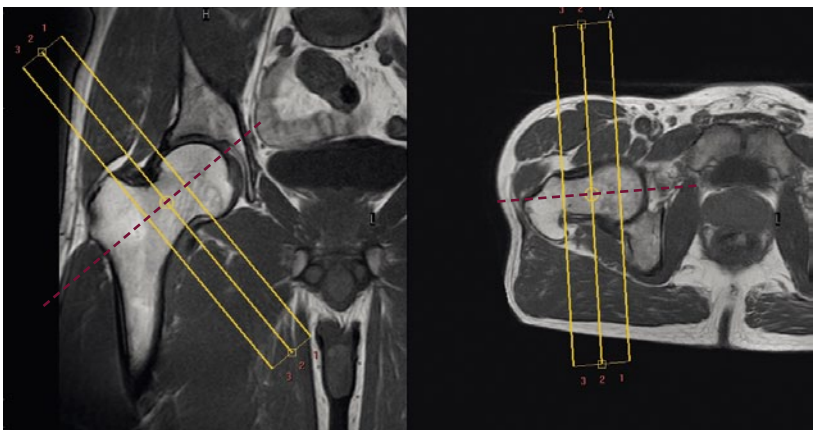
Tip 5: ExamCards

The angles and offsets of the hip anatomy, from the right to the left side of the body, will change for each unilateral hip planned. By creating a dedicated right and a dedicated left radial hip ExamCard, incorrect angulations will not be traded from one side to the other. Examples of these ExamCards using the SENSE Flex M and SENSE Flex L coils are available on NetForum.

Tip 6: Planning in-line with the femoral neck

To study the femoral head-neck junction over its full circumference – instead of only anteriorly as in the conventional oblique axial method – a radial scan may provide more information in subtle cases of FAI Cam type impingement[4]. Planning differs slightly from a radial scan for evaluation of the labrum. The radial axis should now be in line with the axis of the femoral neck. To achieve this, use a new radial-setup-survey with a different GEO name (e.g. SurRf).

Plan this survey on the initial survey, using the axial and coronal slices that best depict the femoral neck. The radial-setup-survey is planned perpendicular to the femoral neck. The dashed red line indicates the femoral axis to which the radial-setup-survey is perpendicularly aligned. This will provide the correct angulations for the radial scan of the femoral neck. Continue planning as in Tip 4.



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NetForum
www.philips.com/netforum

Visit the MRI NetForum user community for downloading radial hip ExamCards or for more application tips.

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