Configuration and Use of the MR Knee Dot Engine

Kai Reiter (RT); Sebastian Auer (RT)

Radiology Herne, Herne, Germany
We are a radiological joint practice in the heart of the Ruhr district of Germany. At our various magnetic resonance scanners, we perform on every unit between 30–45 MR Imaging (MRI) examinations each day. As a result of the high throughput, we are always interested in ‘Workflow Optimization’. We have, among other things, determined standardized examination protocols. Our MR Knee Dot Engine now goes a step further. Thanks to Dot, the Day Optimizing Throughput Engine and the integrated AutoAlign Knee function, an MR knee examination can now be performed examination-independent with consistent image quality using only a few mouse clicks. Global configurations of the Exam Task Card can also be set automatically with Dot.

Using the AutoAlign Knee function, we have optimized the sequences in such a way that the Technologist at the console only has to check whether enough slices cover the knee. There is no need to re-angle.

In a so-called guidance, helpful tips and figures with tilting can be added to each protocol. Furthermore, the most important protocol parameters can be summarized on an individual parameter card to ensure that beginners are not confused by the number of possible modifications that can be made to the parameters, thus allowing them to concentrate on the most important parameters. Thanks to Dot, our MR beginners are instructed on our 3T MAGNETOM Skyra. Here are a few helpful tips that also apply to other Dot protocols:

First you should think about how the usual clinical questions can be processed with the fewest standardized measuring programs possible:

■ Which protocols are required?
■ With which sequences?
■ In which versions?
■ With which possible optional additional sequences?

Sometimes a rough planning sketch (Fig. 1) helps to clarify the required version and possible additional options and how those can be implemented with the given means of a Dot Engine (strategies, decisions).

In our practice, there are basically two main versions for the knee MRI:

a) Standard knee imaging for an initial finding without contrast agent:
   pd tse fs sag, pd tse fs tra, t1 tse sag, t2 tirm cor. It might be helpful to do a thin slice t2 tse sag to show the anterior cruciate ligament or a 3d t2 DESS to image the cartilage.

b) Post-operative imaging with contrast agent:
   By default, these protocols are scanned with a high bandwidth as these patients have often been provided with metal implants*.
   pd tse fs sag, pd tse fs tra, t1 tse sag, t2 tirm cor. It might be helpful to do a thin slice t2 tse sag, post contrast agent t1 tse fs cor and t1 tse fs sag to show the anterior cruciate ligament.

The schematic sequence that we have thus standardized, including the branching/options specified therein, can be displayed completely using a single Dot Engine.

Implementation

The best way of implementing a Dot Engine is according to the following procedure:
1. Configuration of the Dot Engine basic structure (strategies, options)
2. Assignment of the protocols
3. Adjustment of the workflow properties (copy references, settings, ...)
4. Verification and fine tuning (AutoAlign, Generic view, ...)

*The MRI restrictions (if any) of the metal implant must be considered prior to patient undergoing MRI exam.
1. Configuration

- Go to the examination explorer and enter a new examination.
- Use the right mouse button in the “Exam Properties” and select the corresponding “Body Part” (KNEE). You now have the option to determine the laterality. We have stored “Both” as default in our institute (Fig. 2). Thanks to these few steps, the examiner no longer needs to make these decisions when selecting the patient. The device detects the coil position and will release the “Autocenter” function with the previous patient selection.

Now the foundation of the Dot Engine is determined:

- Press the right mouse button under “Insert” to select “Dot Engine Step” (Fig. 3).
- Now select the “Ortho Patient View” and go to “Edit Configuration”.
- Here, under “Set-up”, the previously determined strategies and the “Clinical decision points” for the additional Ligamentum cruciatum anterius (LCA) sequence are entered (Fig. 3).

TIP: To add strategy names and clinical decision point names select the + icon in the corresponding area of the patient view setup page and type desired name. Secondly, the scout is entered into the exam explorer beneath the ortho patient view independent of a strategy branch. We always scan an AutoAlign Scout. In doing so, a 3D volume is acquired and multiplanar reconstructions (MPRs) are calculated in all 3 planes. Thanks to the AutoAlign Knee algorithms, the sequence is angled using landmarks. The Technologist only needs to check whether there are sufficient slices covering the knee and respond accordingly.
2. Protocol assignment

The remaining sequences must now be entered as follows:

- In the context menu under the right mouse button, select "Insert".
- Select "Strategy Branch", enter the sequence weighting name, e.g. t1 sag and confirm.
- Double-click to open the sequence weighting name.

The previously entered strategies "Standard" and "Post surgery" are displayed.

In both strategy folders, each of the respective sequence sequences must now be entered, e.g. with "Standard" a normal t1_tse_sag and with "Post surgery", a t1_tse_sag_high_bw (Fig. 4).

Repeat this maneuver until all sequences have been assigned to the respective strategy branches and strategies.

In the next step, the LCA sequence is saved as "Clinical decision points".

- In the context menu under the right mouse button, select "Insert" and "Decision Step".
- Select the decision "LCA" and "Confirm decision before start" (Fig. 5) and confirm with ok.
- Double-click on the LCA branch and add additional LCA sequences (t2_tse_sag_thin) in the branch "with LCA".
For the next option or decision, insert the 3D sequence and inline MPR which will be saved as a “Clinical decision points”.

- Use the right mouse button to insert “Decision Step”. Select the decision “3D” and “Confirm decision before start” and confirm with ok.
- Double-click on the “3D” decision branch and add additional 3D sequences (t2_dess) in the branch “with 3d”. After the t2_DESS sequence is inserted, use the right mouse button and go to the sequence properties, Dot add-in and from the drop down menu choose “MPR Assignment” and confirm with ok (Fig. 6).

Now an additional “Decision step” is entered that is used to select the “MPR Planning” (Fig. 7). This has the advantage that the respective postprocessing MPRs can be planned before the 3D sequence is scanned and automatically carried out following the measurement. Postprocessing the 3D sequences can no longer be forgotten.

TIP: To insert MPR Planning:
1. Insert “mpr planning” name in the ortho patient view properties > setup within the clinical decision area.
2. Right mouse button: Insert a decision step within the “with 3D” decision branch.
3. Select the Dot add-in tab and change the drop down menu item from basic decision to MPR Planning.
4. Finally select “edit configuration” icon then the set-up tab. Here the inline MPR views wanted can be configured for orientation, FOV, slices etc.
5. Click ok to confirm changes.

The last two sequences for the strategy post-contrast t1 sag pcm and t1 cor pcm will each be entered in their respective “Strategy Branches”.

In doing so, the “Standard Strategy” remains empty as the examination is completed after the 3D branch.
3. Adjusting the workflow properties

The number of slices, the resolution, the field-of-view (FOV) as well as all other parameters are set here and the copy references are assigned. You have to switch to Simulator Mode and determine the copy references for the “Standard” and for the “Post Surgery” strategy (Fig. 8).

4. Verification and fine tuning

The Dot-Engine works best when you use the AutoAlign settings. The following settings exist:

1. Knee Standard: sagittal plane and coronal level
2. Knee Meniscus: coronal and sagittal plane at the height of the joint gap
3. Knee Patella routine: transversal
4. Knee Patella cartilage: transversal angled to the patella
5. Knee Femur cartilage: transversal angled to the femur
6. Knee ACL: angled for the front cruciate ligament
7. Knee PCL: angled for the rear cruciate ligament

Open the sequence and in “Routine” card, select the respective algorithm for the sequence under “AutoAlign”. We use the “Knee Standard” setting for the sagittal plane and coronal sequence and the “Knee Patella routine” for the transversal patella sequence.

The “Knee ACL” algorithm is stored for the ACL sequence.

AutoAlign detects the laterality of the examined knee and suggests the appropriate tilting.

Guidance information is stored in the opened protocol under “Set-up”. Select the sequence and, under “Set-up”, set the guidance protocol instructions and instruction figures to show how the angulation is carried out. On the configuration card “Parameters”, we have determined that only the following parameters should be displayed: Slices, Thickness, FOV readout, FOV phase, TR and Concatenations (Fig. 9).
When applying the MR Knee Dot Engine this is what happens (Fig. 10):
The sequence has been successfully angled in the system thanks to AutoAlign.
The parameter card is clearly laid out and easy to use.

What’s your favorite Dot Feature?

“In some pathologies, we need to obtain inter-examination reproducibility and to be able to carry out examinations swiftly. In the area of knee pathology in particular, Dot and its AutoAlign function have enabled us to position slices automatically without the need for user intervention.”

Alexandre Fuchs, MD
Radiologist
Imagerie Médicale Sainte Marie, Osny, France

“One of the major benefits of Dot is that it provides us with a relatively easy way to perform slice positioning through a library of images, which guide the user to specific anatomical points by means of landmarks.”

Romain Olliac, Technologist
Service de Radiologie Polyvalente Diagnostique et Interventionnelle Hôpital Pitié-Salpêtrière, Paris, France
What’s your favorite Dot Feature?

Dot (Day optimizing throughput) is the most comprehensive MRI workflow solution, and it helps take the complexity out of MRI. Dot has now established itself in the field and our customers have told us what they like best about Dot:

“Within our environment, we just could not provide a cardiac MRI service without the Cardiac Dot Engine.”
Dr. Russell Bull, MRCP, FRCR
Consultant Radiologist
Royal Bournemouth Hospital, Bournemouth, UK

“The Dot Decisions functionality in Abdomen Dot has enabled us to schematize and simplify these protocols. With Dot, we can now ensure our examinations are far more reproducible and of excellent quality.”
Arnaud Lambert
Technologist
Imagerie Médicale Saint Marie, Osny, France

“Cardiac Dot (Engine) allows us to obtain automatic positioning of the main slices necessary to evaluate cardiac function with a high degree of reproducibility.”
Professor Philippe Cluzel, MD, PhD
Service de Radiologie Polyvalente Diagnostique et Interventionnelle Hôpital Pitié-Salpêtrière, Paris, France

“AutoAlign is helpful especially for colleagues who rarely perform knee examinations because the slices are positioned automatically, which saves a lot of time. Furthermore, our knee examinations have become reproducible.”
Linda Willeke
Technologist
St. Franziskus Hospital, Münster, Germany

Experience a Dot workflow yourself and hear from more customers at www.siemens.com/Dot
Dot is now available for 3T MAGNETOM Skyra and MAGNETOM Verio and for 1.5T MAGNETOM Aera and MAGNETOM Avanto.