How to Measure the Tibial Tuberosity to Trochlear Groove Distance on MRI

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The tibial tuberosity to trochlear groove (TT-TG) distance is a radiographic measurement used primarily to assess patellar instability (which occurs when the kneecap slips out of place). It measures the lateral offset between the deepest part of the trochlear groove and the point where the patellar tendon attaches to the shinbone.

How often is this measurement requested?

The TT-TG measurement is often requested in orthopedic clinics, specifically for patients presenting with the following issues:

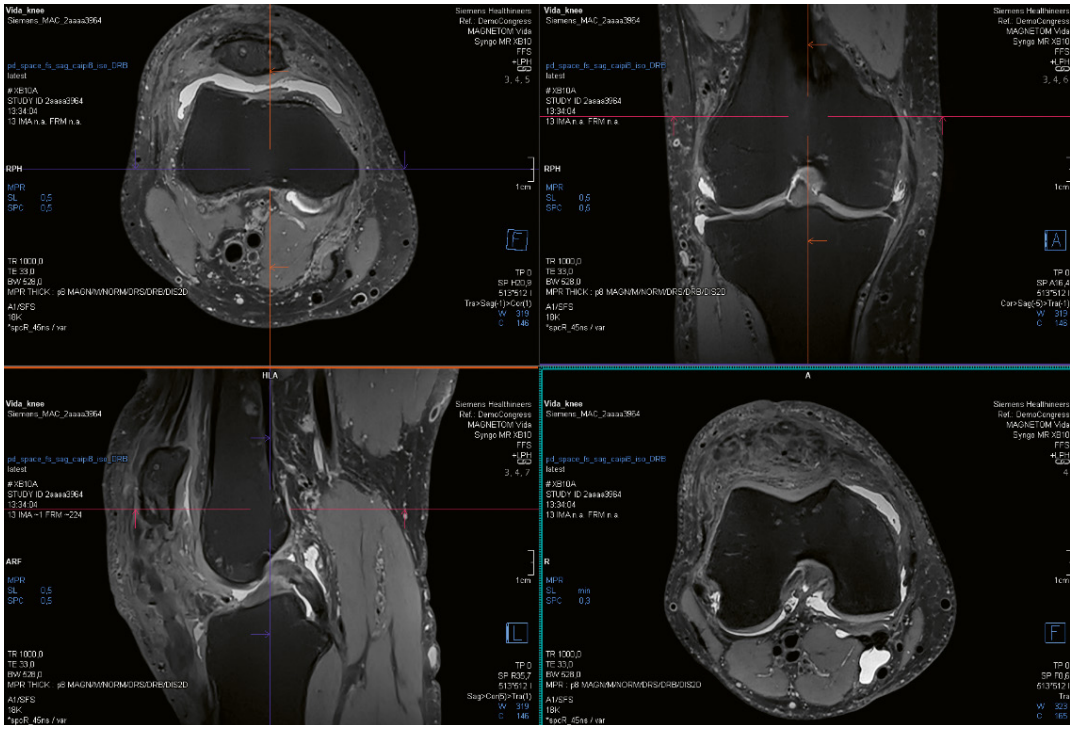
- Recurrent patellar dislocations
- Chronic kneecap pain (patellofemoral pain syndrome)
- Patellar maltracking

If a surgeon is considering an operation to stabilize the kneecap, the TT-TG distance is part of the standard preoperative workup.

The measurement is typically performed using computed tomography (CT) or magnetic resonance imaging (MRI). Radiologists take two cross-sectional images: one at the level of the trochlea and one at the level of the tibial tuberosity. They then superimpose the images to measure the horizontal distance between the two points.

Historically, CT was the gold standard examination for this measurement, partially because the modality can provide 3D acquisitions. Nowadays, MRI can perform 3D acquisitions with thin slices very similar to CT, and it brings additional advantages such as different contrasts (achieved with T1, T2, PD, fat-sat, or zero echo time imaging PETRA) that show the cartilage and ligaments at the same time without ionizing radiation. Another advantage of MRI is the possibility of reliably measuring the tibial tuberosity to posterior cruciate ligament distance (TT-PCL). This information helps determine if the instability failure is purely due to the tibial bone.

The acquisition time for an isotropic 3D T1 SPACE sequence with 0.33 mm slice thickness is around 3 minutes. If the radiologist requests a 3D FS acquisition, it can be done in around 4 minutes (Fig. 1). Even the PETRA sequence can be done with 0.6 mm slice thickness (Fig. 2).



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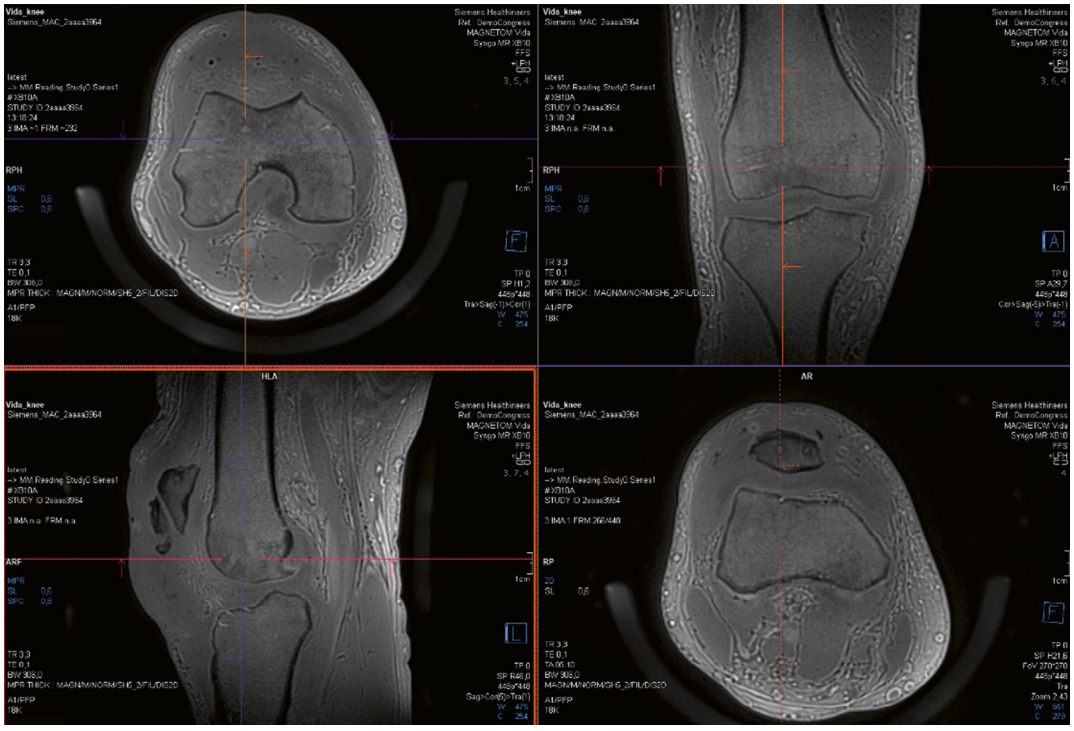
1 Proton density-weighted SPACE fs (Pd_Spce_ fs_sag_caip8_) in an acquisition time of 3:07 minutes.



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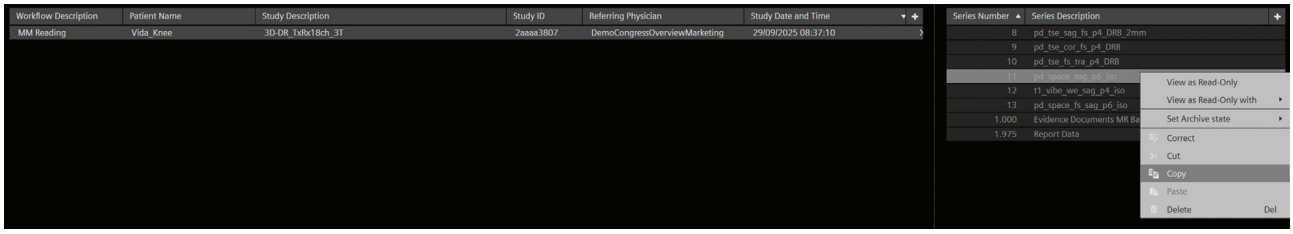
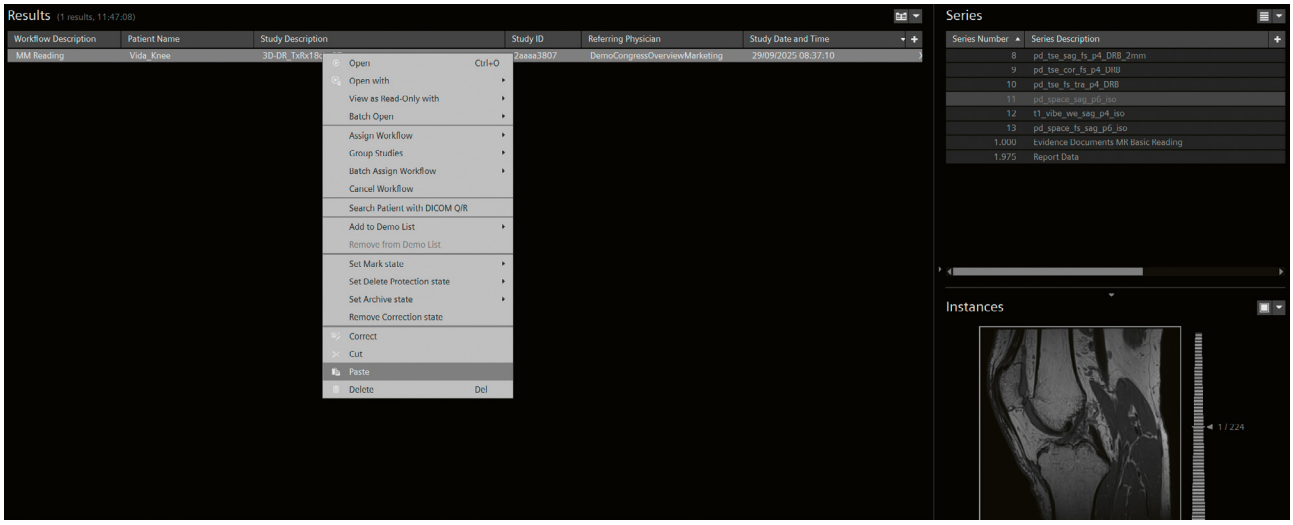
2 PETRA (zero TE) sequence in an acquisition time of 5:10 minutes.

Here is a step-by-step guide for measuring the TT-GT distance.

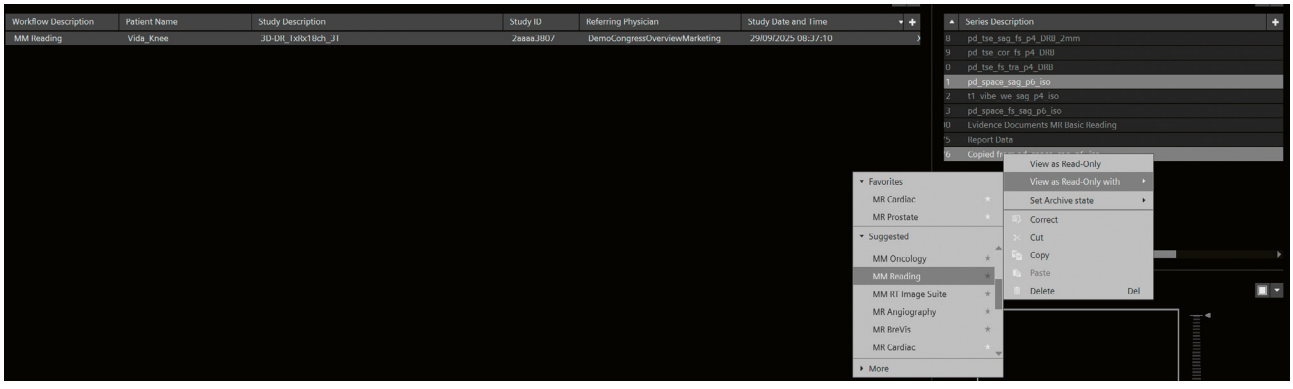
1) Choose the 3D acquisition and copy the sequence from the Series level.



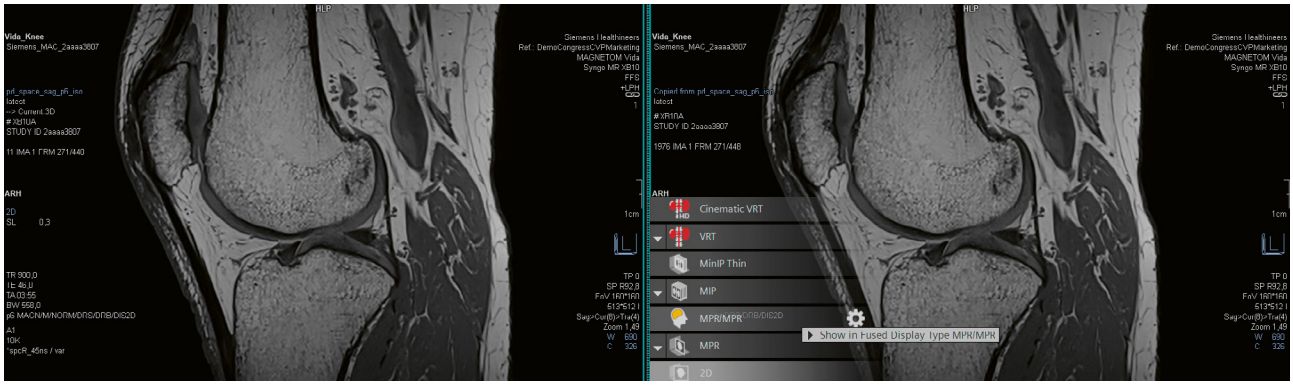
2) Select the patient's name and paste the sequence on the Results level.



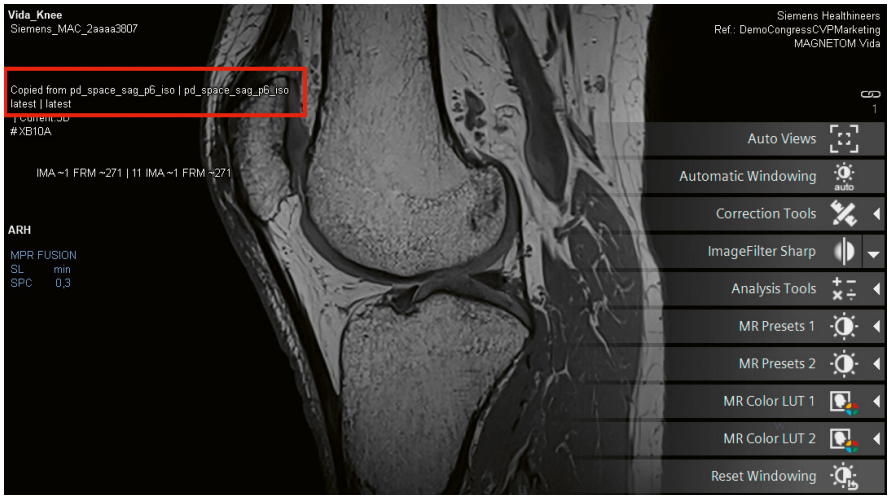
3) Select both series on the Series level and open them on the *syngo*.via multimodality reading workflow (MM Reading).



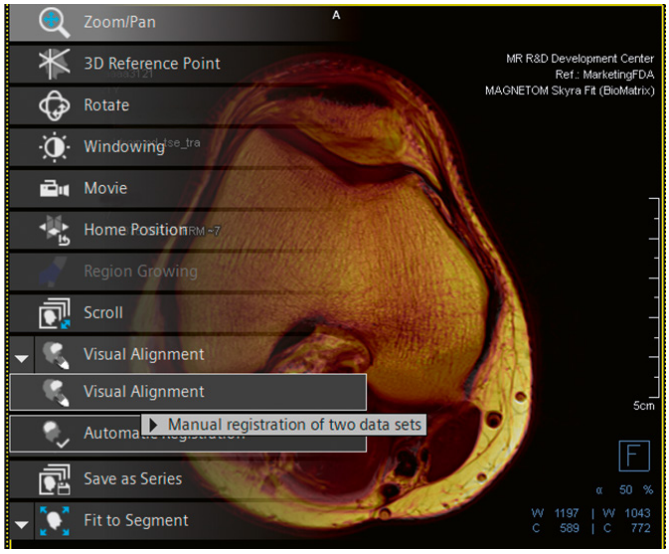
4) Press and hold the Ctrl key to select both images. Use the MPR/MPR option in the bottom left corner to fuse the images.



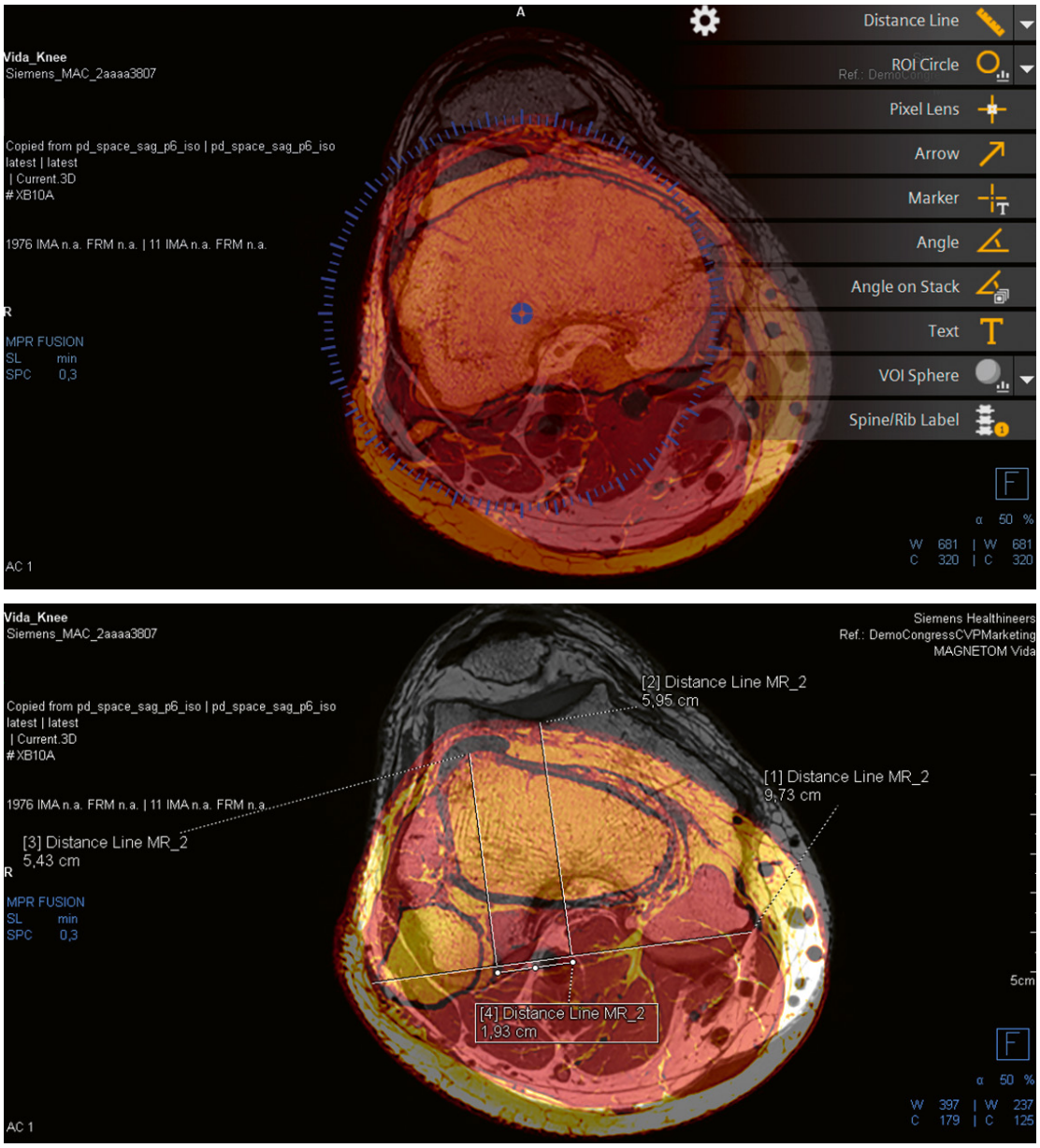
5) Define a color lookup table (LUT) for one of the images (MR Color LUT 2).
You can easily confirm the fusion sequence by checking the sequence names (they should be a combination of the two names).



6) Change the orientation to transversal view and open the Visual Alignment option in the top left corner.



7) Press the Ctrl and Shift keys to scroll the images in one volume. In the top right corner, select Distance Line or Angle to do the measuring.



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References

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2 Heidenreich MJ, Camp CL, Dahm DL, Stuart MJ, Levy BA, Krych AJ. The contribution of the tibial tubercle to patellar instability: analysis of tibial tubercle-trochlear groove (TT-TG) and tibial tubercle-posterior cruciate ligament (TT-PCL) distances. Knee Surg Sports Traumatol Arthrosc [Internet]. 2017;25(8):2347–2351. doi: 10.1007/s00167-015-3715-4