Purpose and Summary

This protocol describes the guidelines for a CT and MRI scan intended for the creation of Ricoh 3D for Healthcare Orthopedic Anatomic Models.

Important

Use of this scanning protocol as a guideline will result in a more anatomic accurate model. A clear visualization of bone structures is needed. Image quality should reach a level required for radiological evaluations of the bone. Deviations from this protocol may result in an unusable scan and delay of surgery.

Preparation of the Patient

- Discuss the procedure with the patient and instruct not to move during scanning. The patient must not move during any part of the scanning sequence. Patient movement will alter the relative alignment of the joints and invalidate the scan.
- Remove any non-fixed metal prosthesis, jewelry, or zippers that might interfere with the region to be scanned.
- Position the patient to maximize comfort and minimize motion. Use straps, sandbags, and sponges as needed to immobilize the patient.

In the Presence of Metal

- Check whether strategies of optimizing scan parameters to reduce metal artifacts seem beneficial; such as using thin slice collimation and reconstructing to slices of 1.25 mm, lowering pitch, and increasing kVp.
- Use a Metal Artifact Reducing algorithm/ filter, if available. Submit this along with the standard scan.
- Increase the HU scan range by using a 16 bit or extended CT scale, if available.

Dose Optimization

- Adjust parameters depending on patient body habitus (e.g. kVp, mAs).
- Dose information displayed at your scanner (such as CTDIvol) can be used to optimize scan parameters.
- Apply dose reduction techniques such as automatic tube current modulation and automatic voltage selection whenever possible and applicable (e.g. only apply automatic tube current modulation when your system can apply it correctly in the presence of metal in the scan region).
- For patients of standard body size without metal implants it is often possible to use a low-dose protocol for bone imaging and 3D applications.

- Tip: On some scanners, prospective selection of thin reconstructed slice thickness (e.g. 1mm) can lead to higher doses. Consider a retrospective reconstruction from thin acquisitions according to scan protocol parameters (Image Type needs to be ORIGINAL).

CT Scanning Parameters

Orthopedic	
Scanner Type	Multi-detector row CT with number of detector rows ≥ 16
Scan Mode	Helical
Collimation	Slice thickness: 1.25 mm or smaller Slice increment: contiguous or overlapping slices (50% overlap): slice increment ≤ slice thickness
Gantry tilt/oblique angle	0°
kVp	90-140 (automatic voltage selection, if available)
mAs	Automatic tube current modulation
Rotation Time	Use 1-second or smaller
Pitch	Use 1 or smaller
Field of View (FOV)	Scan all slices with the same FOV, reconstruction center AND table height (coordinate system).
Matrix	Use a 512 x 512 matrix
Reconstruction Algorithm	Use the following reconstruction algorithms and provide axial images: 1) Use a standard or soft tissue algorithm without edge enhancement. Always provide this reconstruction. 2) Axial images must be provided. No reformatting, no oblique reconstructions; no MPRs. 3) If metal is present, provide additional reconstruction(s) with metal artifact reduction applied if available. (Always provide a reconstruction without metal artifact reduction applied.) Reconstructions should be obtained from one single acquisition.
HU Scale	If metal implants are present, use a HU scale of 16-bit.

MRI Scanning Parameters

Orthopedic	
Scanner Type	Isotropic 3D T2 and T1 (Pre and post T1 CE if looking for a mass)
Sequence	3D
Collimation	Slice thickness: 1.25 mm or smaller Slice increment: contiguous or overlapping slices (50% overlap): slice increment ≤ slice thickness
Phase	80-100%; Phase Direction AP. Do not use “No Phase Wrap, Oversampling, or Folder Over Suppression
Field of View (FOV)	Scan all slices with the same FOV, reconstruction center AND table height (coordinate system).
Matrix	Use a 512 x 512 matrix
TE	Scanner specific
Bandwidth	Scanner specific
Fat Saturation	Scanner specific