

CT Scans for *VirtuOst*[®]

Overview of CT Selection for *VirtuOst* BCT and *VirtuOst* VFA: *VirtuOst* BCT uses new or previously taken CT scans that capture the hip or lower spine to measure bone mineral density and bone strength. This information can be used by a physician to assess fracture risk, identify osteoporosis, and monitor therapy. For spine-containing CT scans, *VirtuOst* VFA can be ordered as an add-on option to *VirtuOst* BCT to visualize and measure vertebral deformities, classify the type and grade of any existing vertebral fracture, and from this identify patients at high risk of a future osteoporosis-related fracture. This guide summarizes the required CT scan parameters for *VirtuOst* BCT and *VirtuOst* VFA, provides a list of CPT codes for BCT-eligible CT scans taken for other indications, and offers approaches to establishing a CT scan protocol for patients who will obtain a new CT that is taken specifically for BCT.

Which Types of Previously Taken or Pending CT Scans Can Be Analyzed? Most pelvic, abdomen, spine, chest, low-dose lung, and whole-body PET/CT scans can be analyzed if they adequately cover one proximal femur (lesser trochanter and above) or one complete vertebral body from T12–L3¹. An external calibration phantom is not required. CT scan requirements for *VirtuOst* are specified in **Table 1** and **Table 2**, and CPT codes for specific CT scans eligible for *VirtuOst* are provided in **Table 3**². If the scan protocol requirements in **Table 1** and **Table 2** are met and there are no significant imaging or enhancement artifacts that are uninterpretable, *VirtuOst* is quite robust to typical clinical variations in scan acquisition and reconstruction settings.

What Scans Settings Are Not Permitted? As outlined in **Table 1** for BCT, the tube voltage cannot be lower than 100 kVp, the bone region of interest must not be truncated in the image, and a metal implant cannot appear anywhere in the transverse cross-section of the bone to be analyzed. For example, a metal implant in one hip will prevent analysis of the contra-lateral hip. "Sharp" kernels are less preferable as they can distort the bone density information in the image. The requirements for axial slice thickness of the reconstructed image and for intravenous (IV) contrast differ between the spine and hip:

- For BCT at the spine, the slice thickness cannot exceed 3.0 mm and the CT scan cannot be enhanced with IV contrast.
- For VFA (at the spine), the slice thickness cannot exceed 3.0 mm; IV contrast is not a problem.
- For BCT at the hip, the slice thickness cannot exceed 5.0 mm; IV contrast is not a problem.

If an ordered *VirtuOst* BCT or *VirtuOst* VFA cannot be performed for a submitted CT scan, an explanation for why the analysis could not be performed will be provided in the results report.

Performing a New CT Scan Specifically for *VirtuOst* BCT³: If no suitable CT scan exists, a new CT scan may be ordered specifically for BCT (CPT code 0558T). This code should not be reported in conjunction with any of the codes in the 71000–75000 range listed in **Table 3**. Protocols for such a new CT scan should meet the requirements for *VirtuOst* BCT of both the hip and the spine — such as a protocol for an Abdomen/Pelvis CT w/o contrast — while minimizing patient dose by the As Low As Reasonably Achievable (ALARA) principle. The American Association of Physicists in Medicine have published recommended vendor protocols for **Routine Adult Abdomen/Pelvis CT**⁴ that may be used. Suitable low-dose protocols could follow the AAPM's published **Adult CT Colonography**⁵ scan protocols using the supine scan parameters without dye.

1. Keaveny et al: Biomechanical Computed Tomography analysis (BCT) for clinical assessment of osteoporosis. *Osteoporos Int*, 31:1025–48, 2020.

2. Adams et al: Osteoporosis and hip fracture risk from routine computed tomography scans: the Fracture, Osteoporosis, and CT Utilization Study (FOCUS). *J Bone Miner Res*, 33:1291–1301, 2018.

3. This information is not meant to be used as a substitute for the review of scan protocols by a qualified and certified professional and is intended as a reference guideline only. Each new scan requires medical judgement by trained and qualified professionals when exposing patients to ionizing radiation.

4. "Routine Adult Abdomen/Pelvis CT Protocols", 7 August 2015. [Online]. Available: <https://www.aapm.org/pubs/CTProtocols/documents/AdultAbdomenPelvisCT.pdf>.

5. "Adult CT Colonography Protocols", American Association of Physicists in Medicine, 30 November 2017. [Online]. Available: <https://www.aapm.org/pubs/CTProtocols/documents/AdultCTColonography.pdf>.

Table 1 - VirtuOst BCT Scan Protocol Requirements

Parameter	Requirement	Preference
Tube Voltage	100–140 kVp	120 kVp
Display Field of View (DFOV)	The bone of interest must not be cut off in the FOV	≥ 30 cm (“large FOV”)
Reconstruction Kernel	<p>“Soft” to standard reconstruction kernels are preferred</p> <p>“Sharp” or “Bone” kernels are less preferable but are acceptable</p>	<p>Examples of suitable kernels:</p> <ul style="list-style-type: none"> • GE: Standard, Soft, Lung • Siemens: B30/31, B20, B40/41, I30/31, I20, I40/41 • Philips: B, A, C • Canon: FC12
Hip-Specific		
Coverage	Just above the top of the femoral head to just below the femoral neck	1 cm above top of femoral head to 2 cm below the lesser trochanter
IV Contrast	With or without	Without
Slice Thickness	≤ 5.0 mm	0.5–2.0 mm thickness; thinner is better
Spine-Specific		
Coverage	Complete coverage of one vertebral body from T12-L3	1 cm above to 1 cm below L1
IV Contrast	Without (BCT is not performed at the spine for scans with IV contrast)	Without (no choice)
Slice Thickness	≤ 3.0 mm	0.5–2.0 mm thickness; thinner is better

Table 2 - VirtuOst VFA Scan Protocol Requirements

Parameter	Requirement	Preference
Tube Voltage	80–140 kVp	
Display Field of View (DFOV)	FOV must contain one or more complete vertebrae from T4-L4	
Reconstruction Kernel	No restrictions	
Coverage	One or more complete vertebrae from T4-L4	All levels from T4-L4
Contrast	With or without IV contrast	
Slice Thickness	≤ 3.0 mm	0.5–2.0 mm thickness; thinner is better

Table 3 - Eligible CT Scans for VirtuOst

Scan Description	CPT Code	Hip BCT	Spine BCT*	VFA
Chest w/o	71250		X †	X
Chest with & w/o	71270		X †	X
Low-dose lung cancer screen	71271		X †	X
Thoracic w/o	72128		X	X
Thoracic with & w/o	72130		X	X
Lumbar w/o	72131		X	X
Lumbar with & w/o	72133		X	X
Pelvis w/o	72192	X		
Pelvis with	72193	X		
Pelvis with & w/o	72194	X		
CT lower extremity w/o	73700	X †		
CT lower extremity with	73701	X †		
CT lower extremity with & w/o	73702	X †		
Abdomen w/o	74150	X †	X	X
Abdomen with	74160	X †		X
Abdomen with & w/o	74170	X †	X	X
CTA abdomen/pelvis with & w/o	74174	X	X ††	X
CTA abdomen with & w/o	74175	X †	X ††	X
Abdomen/pelvis w/o	74176	X	X	X
Abdomen/pelvis with	74177	X		X
Abdomen/pelvis with & w/o	74178	X	X	X
CT colonography DX	74261	X	X	X
CT colonography DX w/dye	74262	X	X	X
CT colonography screening	74263	X	X	X
PET-CT, limited §	78814	X †	X †	X †
PET-CT, skull base to mid-thigh §	78815	X	X	X
PET-CT, whole body §	78816	X	X	X
CT scan taken for BCT	0558T	X	X	X

* Slice thickness must be ≤ 3 mm for Spine BCT and VFA; no IV contrast is allowed for Spine BCT.

† Check protocol and/or scan for adequate anatomic coverage.

†† For CTA scans, BCT Spine can only be performed if an image w/o contrast is also acquired.

§ For PET-CT, the non-contrast CT taken for anatomical localization is used for *VirtuOst*.