

CBCT advancements in imaging for orthopedic surgery: Enhancing precision and patient outcomes



The orthopedic surgery market in the U.S. is experiencing significant growth, driven by factors such as an aging population, technological advancements and an increase in musculoskeletal disorders.

For hospitals and ambulatory surgery centers (ASCs), orthopedic surgery is a top revenue driver and quality outcomes are crucial. When one thinks of new technology in orthopedics, imaging doesn't typically come to mind. But it should. Imaging is a vital component in the diagnosis, surgery and follow-up of patients undergoing orthopedic care. New advancements in imaging can facilitate not only increased efficiency for surgeons and better patient outcomes, but also financial savings for the hospital.

Advanced imaging plays a pivotal role in both diagnostic and intraoperative environments. Siemens Healthineers has been a pioneer in this field. They were the first and only system to market and the first to add Cone Beam Computed Tomography (CBCT) to their diagnostic radiology system, The Multitom Rax (Rax).

CBCT is an advanced 3D X-ray providing detailed images of bones and joints, enabling more precision diagnosis and treatment of fractures. The X-ray tube and detector rotate up to 200 degrees around the patient obtaining multiple 2D X-ray images that are post-processed to yield a true 3D image.

The Rax system is a twin robotic system with Real3D that provides detailed imaging in supine and upright positions. The system's multiple trajectories enable imaging of different anatomical structures, enhancing the precision and effectiveness of orthopedic surgery planning. Moreover, this flexibility improves patient comfort and patient experience because you move the system, not the patient.

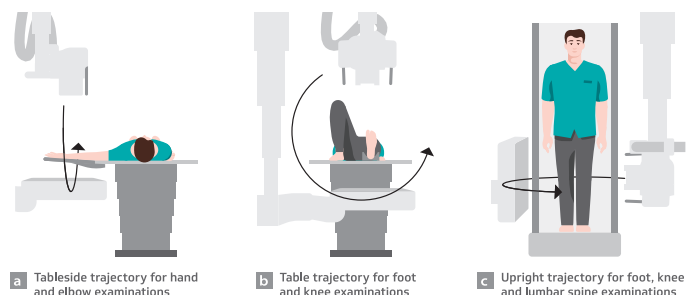


Diagram shows the flexibility of imaging various peripheral anatomy using the Rax.

An excellent example showing the benefit of Real3D in orthopedic cases is small bone and joint trauma. A study by Grunz et. al. compared standard 2D radiography and CBCT in patients with small joint trauma. The results concluded that compared to 2D, Real3D significantly detected more fractures, joint involvement and multifragmenting injuries.¹ In fact, among the patients imaged with CBCT, treatment plans were changed based on additional information acquired from CBCT in 31% of the cases, and six fractures were ruled out.

The Rax's ability to perform weight-bearing imaging of the spine while standing is crucial. (See True2scale Body Scan image below.) This method provides a more accurate representation of joint biomechanics compared to traditional supine imaging like MRI and CT. Upright imaging offers a more accurate depiction of spine pathology as well, making it more effective for diagnosis and treatment planning. This approach could lead to improved prosthesis selection or surgery planning for patients with pain in weight-bearing positions.²



Images using True2scale Body Scan on the Rax for supine and standing imaging in a scoliosis patient.

Additional tools commonly used in diagnostic radiography specific to orthopedics include stitching and slot scanning. Orthopedic stitching software combines multiple overlapping X-ray images into one full-length view of the spine or lower limbs, assessing alignment, limb length and deformities. Slot scanning enhances orthopedic imaging accuracy by capturing a continuous, distortion-free image. Its narrow, collimated X-ray beam preserves true anatomical proportions, while reduced scatter radiation improves sharpness and contrast.^{3,4} These features ensure highly reproducible measurements for scoliosis, limb alignment and surgical planning.

A correct diagnosis means the right treatment is given, whether that's surgery, immobilization, functional therapy or other management. This helps to reduce problems from missed fractures or unnecessary procedures. It also results in better patient outcomes, improved patient satisfaction, increased surgeon efficiency and cost savings for hospitals by minimizing readmissions and extra resource use.



CIARTIC Move Mobile C arm with CBCT capabilities.

Intraoperative CBCT has been gaining some acceptance in orthopedic surgery via mobile C arms. Siemens Healthineers was the first to introduce CBCT in the ARCADIS Orbic 3D mobile C arm in 2004. In the current portfolio, it's been replaced by the CIARTIC Move (Move) and the Cios Spin (Spin). The benefits associated with the use of intraoperative CBCT in orthopedic surgery are well documented.^{5,6}

A study published in the Journal of Orthopedic Surgery and Research evaluated the revision rate of pedicle screw implantations in a patient with and without 3D intraoperative imaging.⁷ The researchers concluded that intraoperative CBCT is a reliable tool for assessing implant positioning and fracture reduction, potentially decreasing the necessity for postoperative revisions.

Research highlighted in EFORT Open Reviews discussed the advantages of intraoperative CBCT in orthopedic trauma surgery. The study emphasized that immediate control of fracture reduction and implant positioning through high-quality 3D imaging can reduce the need for secondary revision surgeries due to implant malposition.⁸

With high quality 3D imaging for diagnosis and surgical treatment, the Rax, Spin and the Move are poised to provide the patient with an accurate diagnosis and the surgeon with enhanced surgical accuracy. The overall average revision rate for orthopedic surgery was 19%.⁵ Higher revision rates are seen in the heal, tibia, ankle and

foot (36%–20%), all weight-bearing regions. The 90-day episode cost for orthopedic revision surgery in 2019 was \$48,987.⁹ In 2024, the cost for that same surgery increased to \$55,413.09, when indexed for inflation.¹⁰ Significant benefits can be obtained in both the diagnostic and intraoperative orthopedic environments by using CBCT imaging.

The improvements in CBCT technology and other imaging technology are greatly improving orthopedic surgery. These innovations not only improve diagnostic accuracy and surgical precision, but also contribute to better patient outcomes, increased surgeon efficiency and significant cost savings for hospitals. As the orthopedic surgery market continues to grow, using advanced imaging technologies will be crucial in driving quality care and improving overall patient satisfaction.

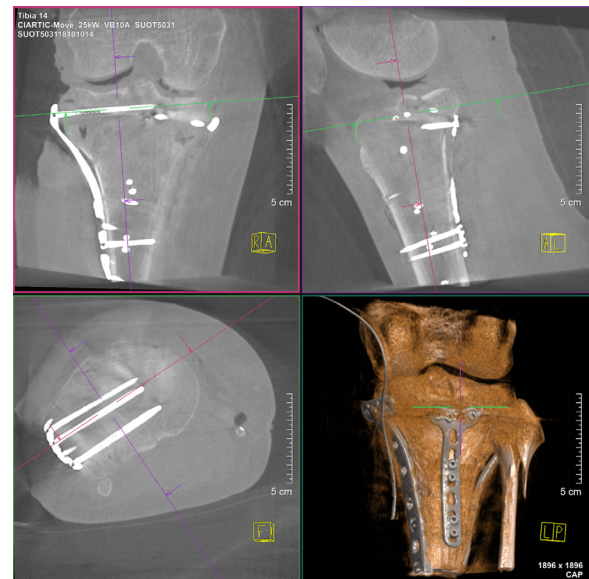


Image of a CBCT done on the Move showing the coronal, sagittal and axial planes and 3D reconstruction of a tibia fracture.

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