The Varian Medical Systems TrueBeam incorporates several new technologies distinguishing it from previous models. First, it uses a completely digital control system. Each subsystem, such as the on-board imaging system, has a control computer that issues commands and monitors the subsystem. The subsystem computers are overseen by a master computer, the supervisor. Second, the waveguide and filter design allows 5 flattened photon energies up to 20 MV. Third, the electron scattering foils are of a new design. Finally, it implements 6 MV and 10 MV flattening filter free (FFF) beams that provide dose rates up to 2400 monitor units per minute.

Acceptance and commissioning are similar to previous models. Beam data collection does not require procedures different from standard photon beams except for the FFF beams. Due to the higher dose per pulse, depth dose and profile measurements may require small corrections to account for changes in the recombination correction factor (Pion). Commissioning of the FFF beams in the Eclipse treatment planning system for calculation with the analytic anisotropic algorithm (AAA) is straightforward. The AAA for FFF beams achieves accuracy comparable to standard flattened beams.

Presently, routine quality assurance procedures are similar to those of previous models. In particular, commercial 5-chamber devices for daily monitoring of output, symmetry, and flatness are sufficient for monitoring the FFF beams as well. Presently, the tighter mechanical specifications of the TrueBeam relative to previous models do not require different QA procedures; however, as treatment techniques emerge that rely on the improved accuracy, new QA techniques will have to be developed.

The digital control system has implications in clinical practice. One example is improved dosimetry of dynamic MLC delivery. It is well known that trajectories requiring leaf velocities faster than the maximum velocity achievable by the MLC result in beam hold-offs and potentially significant dosimetric errors. Such leaf trajectories are delivered accurately on the TrueBeam because the supervisor computer prospectively reduces the dose rate rather than issuing a beam hold only after the MLC has fallen behind the planned position. This characteristic allows previously non-deliverable leaf trajectories that reduce the dose to critical structures to be used on the TrueBeam. The digital control system also has the potential to deliver exotic trajectories, in which all mechanical motions are possible as the beam is delivered with variable dose rate.

The TrueBeam is a general purpose linear accelerator and can be used for all patient types. For conventional fractionation, treatment times are decreased due to reduction in the time required to prepare for delivery of each field. For hypofractionation, radiosurgery, and respiratory gating using the FFF beams, the treatment times are decreased significantly due to the higher dose rate. Reduced treatment time improves patient comfort, targeting accuracy, and patient throughput.

Educational objectives:

1. Describe the TrueBeam system and its differences from previous models.
2. Understand commissioning and quality assurance of the TrueBeam.
3. Understand the clinical implications of the digital control system.
4. Describe clinical use of the TrueBeam capabilities.