An Elite Version of Telecobalt Machine with O-ring Design for Clinical Radiation Therapy

A recent report[1] highlighted the introduction of an elite version telecobalt machine with higher specifications compared to previous models, for isocentric precision clinical radiation therapy. A long-felt need by many researchers and many radiation oncologists[2] is to have comparable radiotherapy executions by telecobalt machines in par with modern linear accelerators. Radiobiological literature indicates that there is no bearing on dose–effect relationship between megavoltage photon beams, which include telecobalt-absorbed doses in planned target volumes. It was brought out in recent reports that cobalt beam quality has an edge over linear accelerator radiotherapy, especially in head-and-neck radical treatments, if tissue deficiency compensation is achieved in the neck region, and preserve dose buildup with a cut window in Orfit immobilization masks.[3] In ongoing clinical trials, it had been highlighted that a tumoricidal dose of 70 Gy could be achieved to tumor volume in overall treatment time of 35 days (5 weeks), with acceptable skin and mucosal morbidities. A daily fraction of 2 Gy was not achievable with linac 6 MV beam quality, in earlier head and neck radiotherapy clinical trials. They restricted a dose/fraction only 1.8Gy and a totaldose of 64 Gy total dose in 5 weeks (35days).[4] As the incidence of head-and-neck malignancy is about 30% to 50% in India and adjacent countries, these results recommend the application of optimized plans with telecobalt beam quality.

The new Design of O –ring model telecobalt machine (Bhabhatron 3i, Bh 3i) manufactured by M/s Panacea Medical Technologies, India, based on indigenous development strategies[1] has upgraded basic specifications, namely use of tungsten collimators, image guidance facility, 6-D special couch, fixed source position, synchronized moving X diaphragm additional collimator synchronized with Multileaf X collimator, computerized multileaf vane movements, and beam catcher. An over travel of 6.25 cm and tongue and groove design of MLC, and different speeds of individual MLC vanes, facilitate incorporated design for dynamic window intensity modulated dose delivery, by DICOM-linked treatment plans. This makes the above model into a high-end precision design of cobalt machine, manufactured in India. The objective scrutiny of different radiation parameters obtained during type approval of Bh 3i highlights the following information. Measured transmissions for both X and Y collimators were 0.23% (mean) and 0.36% (maximum) which is much lower than 2% tolerance limits recommended by regulatory authority (Atomic energy regulatory board). Our measured values of X and Y diaphragm leakage in TrueBeam linear accelerator at Silchar[5] were 0.44% for 6MV and 0.51% for 15 MV. Maximum radiation leakage in the patient's plane was 0.04% (<0.2% tolerance) of the absorbed dose value for 10 × 10 cm^2 field output at normal treatment distance during beam "ON" which is also much less than that of linac. Maximum MLC leaf transmission of Bh 3i is 0.40% which is much less than our TrueBeam linac, namely 1.69% for 6 MV and 1.93% for 15 MV. An improved isocentric accuracy of Bh 3i 0.23 mm had been possible, using the linac O-ring gantry for Bh 3i which is very much necessary for the execution of Volumetric modulated arc therapy (VMAT). Therefore, Bh 3i is designed for delivering conformal, image guidance-based 3D conformal radiation therapy, Field-in-field (FIF) intensity-modulated RT, and mixing of FIF multiple fields with ARC plans and can generate superior sparing of normal tissue and develop good homogeneity in treated volumes. Ring gantry similar to latest linacs gives good stability for volume dose delivery, using 6D-robotic couch both coplanar and noncoplanar treatments. "Krystal" record and verify (R and V) system matches daily acquired images with original plans, which is added facility very much required in clinical trials for verification of treatments. Research efforts are ongoing for beam modeling and inverse optimization options for treatment planning system adoptable to available radiation beam parameters of Bhabhatron 3i machine, to add solutions in present-day telecobalt use.

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Conflicts of interest

There are no conflicts of interest.

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