Purpose:

The treatment of tumors with intra-operative radiotherapy is getting speed in recent years. Treatment if often complicated because of the limited field size of the available applicators. Design of new systems can be simplified by using reliable Monte Carlo models of the existing linac electron beam systems. Results can be reliable only if MC model is stable relative to the reasonably large of the original system. It was found that published model of the linac is very unstable.

Methods:

EGSntc Monte Carlo simulation code BEAMnrc was used for modeling electron beams, because of its proven accuracy in modeling linear accelerator components.

Monte Carlo simulation of the complex electron beam system using the previously published model of the beam source is analyzed. Then simplified model of linac without a collimator was used to simulate similarly simplified hardware.

Results:

While original MC model results fit experimentally measured beam shape very well, Simplified MC model and experimental measurements produce vastly different results.

The MC model showed significant deviation from theory and experimental measurements. MC predicted beam width was ~30% narrower than real one for all simulated energies. Results were compared at several different values of distance from the source.

If used for actual production, results of such simulation would lead to unnecessary thick scattering plates which in turn would increase level of scattered radiation and decrease effective output dose.

Conclusions:

Source of the model instability found to be in wrong beam source modeling.

It is concluded that use of PDD and cross-plane profiles for validation of the full MC system is not reliable method, as it is sometimes very insensitive to the very large perturbations of the beam structure.

Original beam model should be validated using most primitive model possible and only then more sophisticated simulations can be reliably performed.