# Error Estimation Of Preconfigured Beam Data Using New EPOMs from WGTG51 Report 374

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## ABSTRACT

Preconfigured Truebeam data provided by AOS of Varian used the upstream shifts recommended by AAPM TG51, which are 0.6r for photons and 0.5r for electrons. WGTG51 Report 374 updated the EPOM shifts and shifts are ion chamber specific. This suggests that by using the preconfigured Truebeam data, systematic uncertainties will occur.

This study quantifies the systematic uncertainties when using preconfigured data, from both absolute dose calibration and the difference of PDD shifts.

It is concluded that for photons, the uncertainties are no more than 0.36% from PDDs and no more than 0.36% from absolute calibration; for electrons, the PDD difference is 0.8 mm, which should be considered for annual QA criteria, and no more than 0.4 percentage from absolute calibration.

## INTRODUCTION

Varian's new Truebeam LINACS normally are installed with pre-configured beam data entered into the treatment planning system. This can significantly shorten the commissioning time from about four weeks to less than one week. The service is provided by Varian's Advanced Oncology Solutions (AOS) department. Representative Truebeam beam data were modelled carefully and used on all newly installed machines. This is made possible due to the consistency of Truebeam specifications. During the commissioning process, AOS Team will also measure all the relevant beam data, to verify the machine specifics and to serve as baselines for future QAs. Machine will be fine-tuned if the specifications are not within the criteria of the pre-configured beam data.

One issue with the pre-configured data is that the client institution can not readily re-model the beam if the protocol changes. The pre-configured data by AOS used Effective Point of Measurement (EPOM) of 0.6r for photon and 0.5r for electrons. Newly published WGTG51 Report 374 updated the EPOMs, and the new values are ion chamber specific. This study is to quantify the systematic uncertainties introduced by continuing using the pre-configured beam data created before the publication of WGTG51 Report 374.

## METHODS AND MATERIALS

This study specifically examined the pre-configured data for Varian's Truebeam provided by Varian's AOS. These data were measured with IBA CC13 ion chamber (inner radius = 3 mm) and IBA myQA Accept software. The measured data were shifted upstream by 0.6r =1.8 mm for photons and 0.5r = 1.5 mm for electrons in software.

The new MC based EPOM recommended by WGTG51 Rpt. 374 for IBA CC13 is 1.2 mm for photons and 0.7 mm for electrons.

AOS currently does not have a plan to update the data to adopt the new EPOMs at the time of this study. Therefore, understanding the errors introduced by using pre-configured data will be very helpful.

*First*, we examined the errors introduced by PDD itself with different EPOMs, assuming the correct EPOMs are from Rpt. 374; *Second*, we evaluated effects of using different EPOMs when calibrating outputs with TG51.

This study ignores the effects of different PDDs (caused by different EPOM shifts) on Kq, since Kq is not sensitive to PDDs; and ionization-to-dose conversion, since the effect by small variation of EPOM shift is also negligible.

## RESULTS

Errors from PDD itself, for photons, PDDs at 10 cm are off by 0.24% to 0.36% less depending on energies. For electrons, the difference is 0.8 mm. e.g., the depth of 90% dose line will be 0.8 mm shallower for all electrons.

For absolute dose calibration with TG51 using CC13 for depth dose measurements and considering the new EPOMs from Rpt. 374 as 'True' EPOM, using 0.6r as EPOM for photons will introduce errors between 0.24% to 0.36% higher output. However, the calculated dose will match the 'true' dose delivered except at $d_{max}$. Using 'True' EPOM will have output calibrated correctly and calculated dose off by same amount.

For electrons, using 0.5r EPOM will introduce output errors from 0.025 to 0.39 percentage points higher. Using new Rpt. 374 EPOM will introduce differences of 0.1 to 0.4 percentage points between correctly calibrated output and calculated dose. The small difference is due to $d_{ref}$ is close or at the $d_{max}$ where the gradient is low.

## CONCLUSIONS

Clinically the uncertainties introduced by new EPOMs are small, all well less than 1%, which is annual QA tolerance.

However, MPPG 8b recommends using TPS data as baseline, and for electrons, 0.8 mm difference in PDD if using new 'correct' EPOM shift during annual QA PDD scan for electrons will make annual QA hard to pass 1 mm criteria for beam quality (PDD).

Eventually the pre-configured data should be updated to reflect the new EPOMs.

## REFERENCES

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