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Quality Assurance of IMRT plans using IMSure QA™ Software as a substitute for measurement

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Abstract

- **Purpose:** A study was performed to test how appropriate to suspend patient-specific IMRT QA for every patient in the place of independent calculations using IMSure QA software. Furthermore, acceptability criteria of IMRT plans were accessed, and site specific recommendations were determined.
- **Method and Materials:** Point dose data and fluence maps from Eclipse treatment planning system, IMSure, and measurements were evaluated for head and neck and prostate cases. In all 25 prostate and 20 head and neck IMRT cases were included in this study. A three-dimensional portal image-based dose reconstruction program in a virtual phantom (Epidose) was utilized for the comparison of the isocentre dose with Eclipse.
- **Results:** For 5-field prostate, the average percentage discrepancy between IMSure and Eclipse was 0.3% with two third of the cases lying between +/- 0.5%. While the average discrepancy between Epidose and Eclipse was -0.3%+/-0.6%. Similar results were obtained for the 7–field IMRT head and neck; the average discrepancy between IMSure and Eclipse was -0.7% +/-0.8%, while the average discrepancy between Epidose and Eclipse was 0.1% +/- 1.4%. Fluence map comparison of pixels was performed and gamma function values were calculated. The results for the 2% and 3% level discrepancies were derived for prostate and head and neck cases, respectively. For prostate, the average percentage of cells failing the 2% limit was 4.2%+/-1.5%, while for head and neck with 3% limit it was 7.5% +/-2.6%.
- **Conclusions:** Our investigation of the IMSure QA software for IMRT showed good agreement with Eclipse treatment planning system to within 1%. Our results showed that IMSure software can be a reliable tool for IMRT QA, and measurements need to be invoked only for few select patients (less than one third) when point dose discrepancies exceed 1% for prostate and 2% for head and neck cases.

Introduction

- The IMSure QA program uses the 3-source model[1,2] for IMRT calculations which is considered more accurate than the modified Clarkson method.
- IMSure QA imports from the treatment planning system fluence maps, plan parameters and DMLC files. IMSure reconstructs fluence maps based on the DMLC files, and presents pixel by pixel comparison between imported and calculated.
- Point dose calculation can be performed at user selected points. MU calculation can also be performed by assuming absolute point dose values at the user selected point.
- The present study is aimed at finding how appropriate to suspend patient-specific IMRT QA for both head and neck and prostate cases.

Method and Materials

- Output factors fed into IMSure™ were measured with a pinpoint ion chamber. Scatter factors were measured using the same chamber fitted with a brass cap. Dosimetric MLC leaf offset, mean dose leaf leakage, mean fluence map leaf leakage were all tweaked to achieve optimal results for comparison.
- Eclipse™ treatment planning system was used to produce IMRT plans. Fluence maps were exported and point doses were calculated for direct comparison with IMSure.
- Epidose[3] program which is employed in our clinic for three-dimensional portal image-based dose reconstruction in a virtual phantom was utilized for the comparison of the isocentre dose with IMSure. It includes acquiring an electronic portal image for each field, and convolving with a kernel to correct for the lack of scatter. Images are calibrated to a reference field to come up with 3D absolute dose distribution in the virtual cylindrical phantom.

Results

- Fluence maps were reconstructed from dMLC files exported from Eclipse and normalized based on their determined average value. Direct comparison of pixels was performed and gamma function values were derived. Distance to agreement variable was set to zero in the absence of co-registration issues. The results for the 2% and 3% level discrepancies are shown in Figure 1 for head and neck plans and in Figure 2 for prostate plans. For the 2% level, the percentage of failing pixels averaged around 4% for both H&N and prostate plans. For the 3% level, this percentage was 0.9% and 0.2% for H&N prostate plans respectively. .
- Figures 3 and 4 show point dose calculation comparisons. Point dose discrepancies ranged between -2% and +2% for 2/3 of the H&N patients, and between -1% and +1% for 2/3 of the prostate patients. The latter limits can be regarded as QA guidelines for accepting plans.

Results

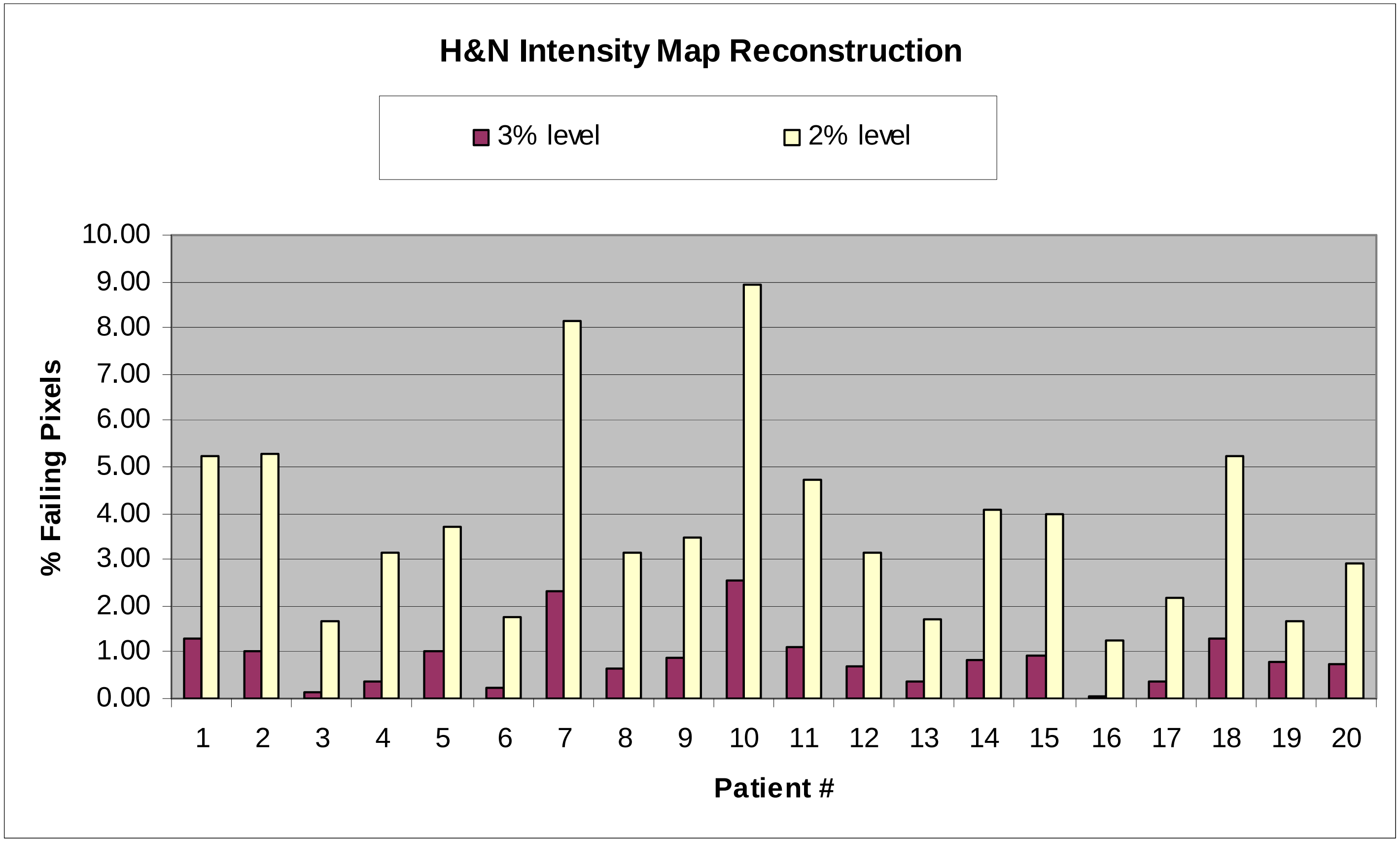

Figure 1: The above bar curves shows the % of failing pixels of all 7-field IMRT H&N plans for the 20 patients studied at the 2 and 3 % level for the gamma function.

Results

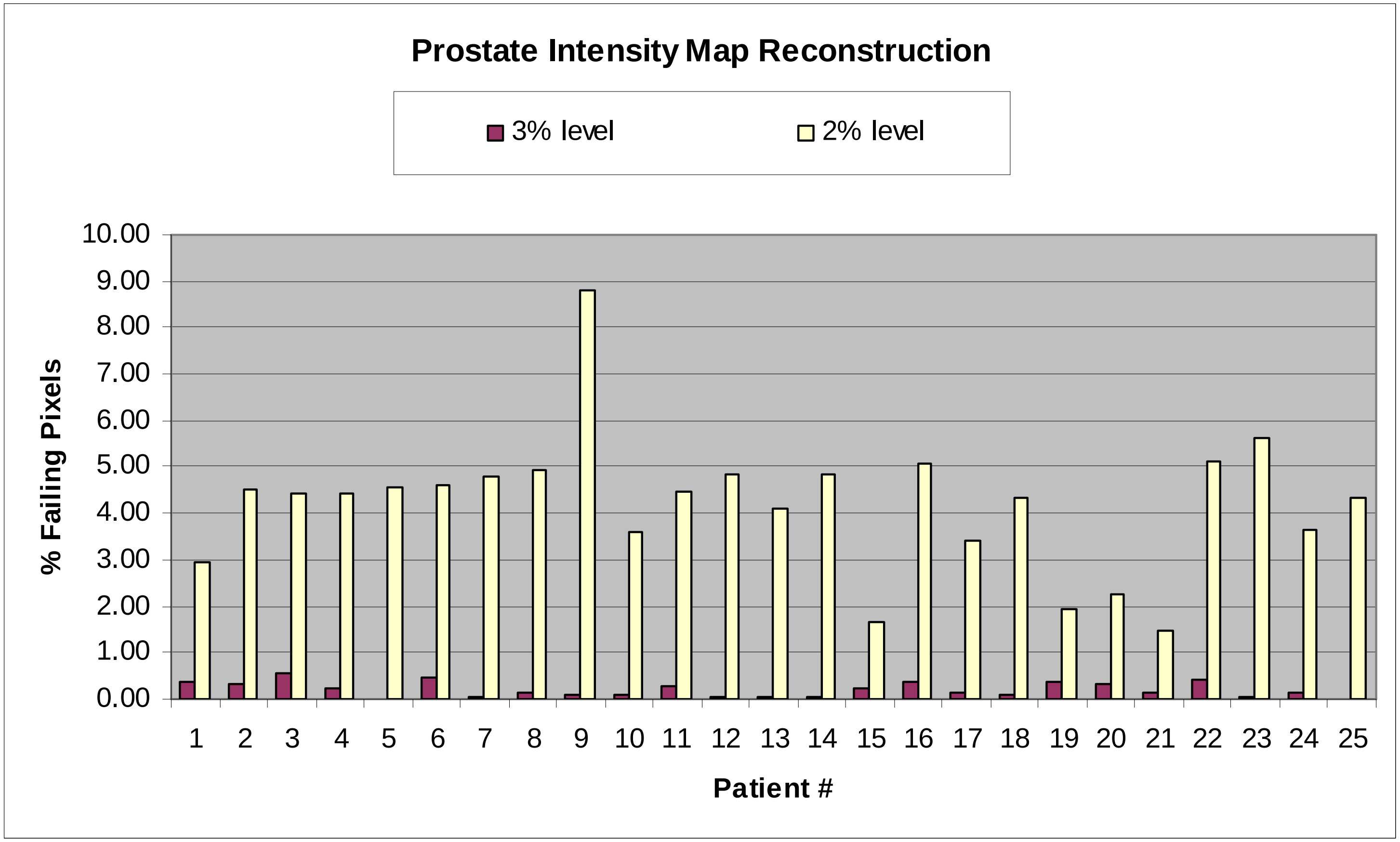

Figure 2: The above bar curves shows the % of failing pixels of all 5-field Prostate IMRT plans for the 25 patients studied at the 2 and 3 % level for the gamma function.

Results

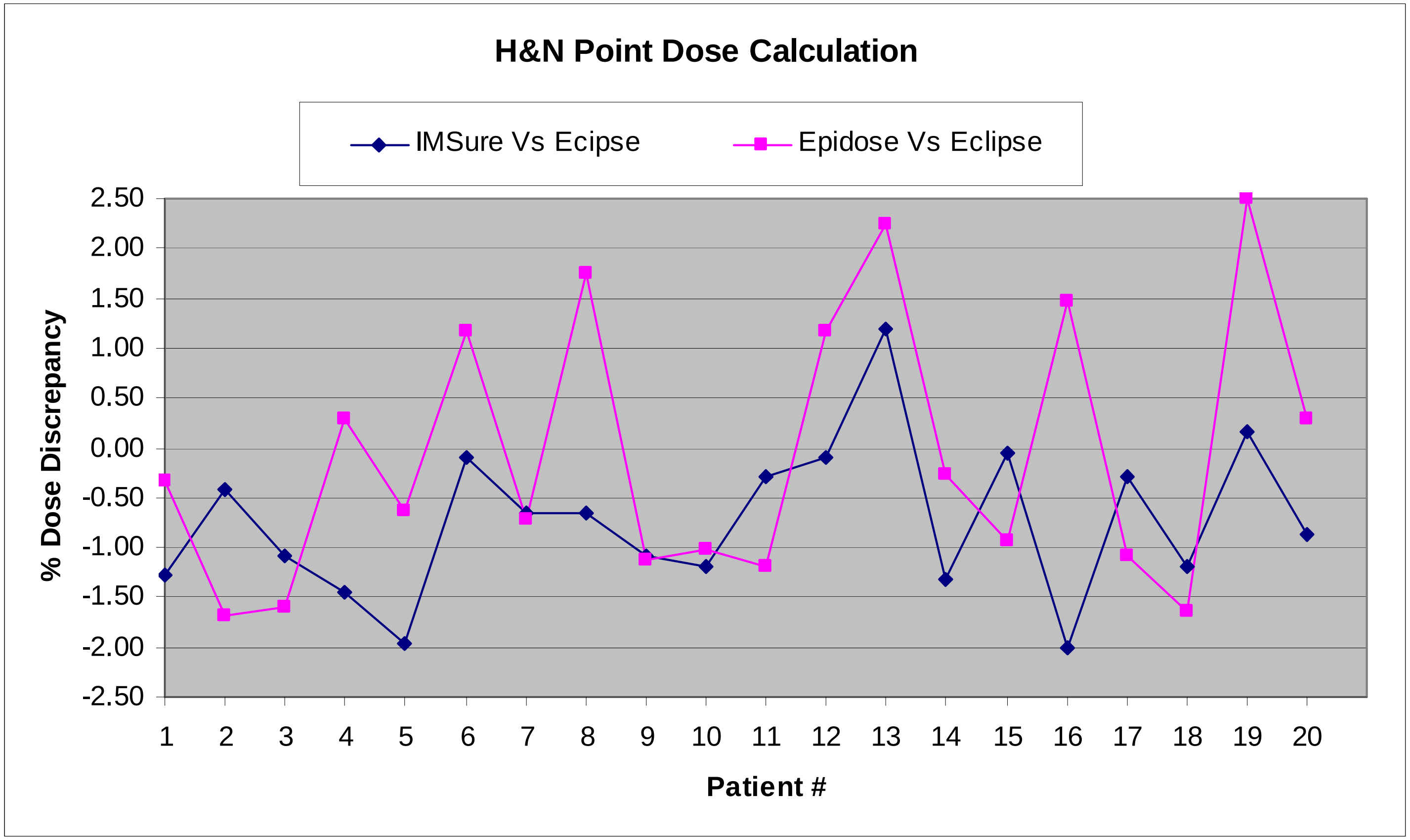

Figure 3: Point dose calculation in IMSure is shown compared to Eclipse and Epidose for the 20 H&N patients studied.

Results

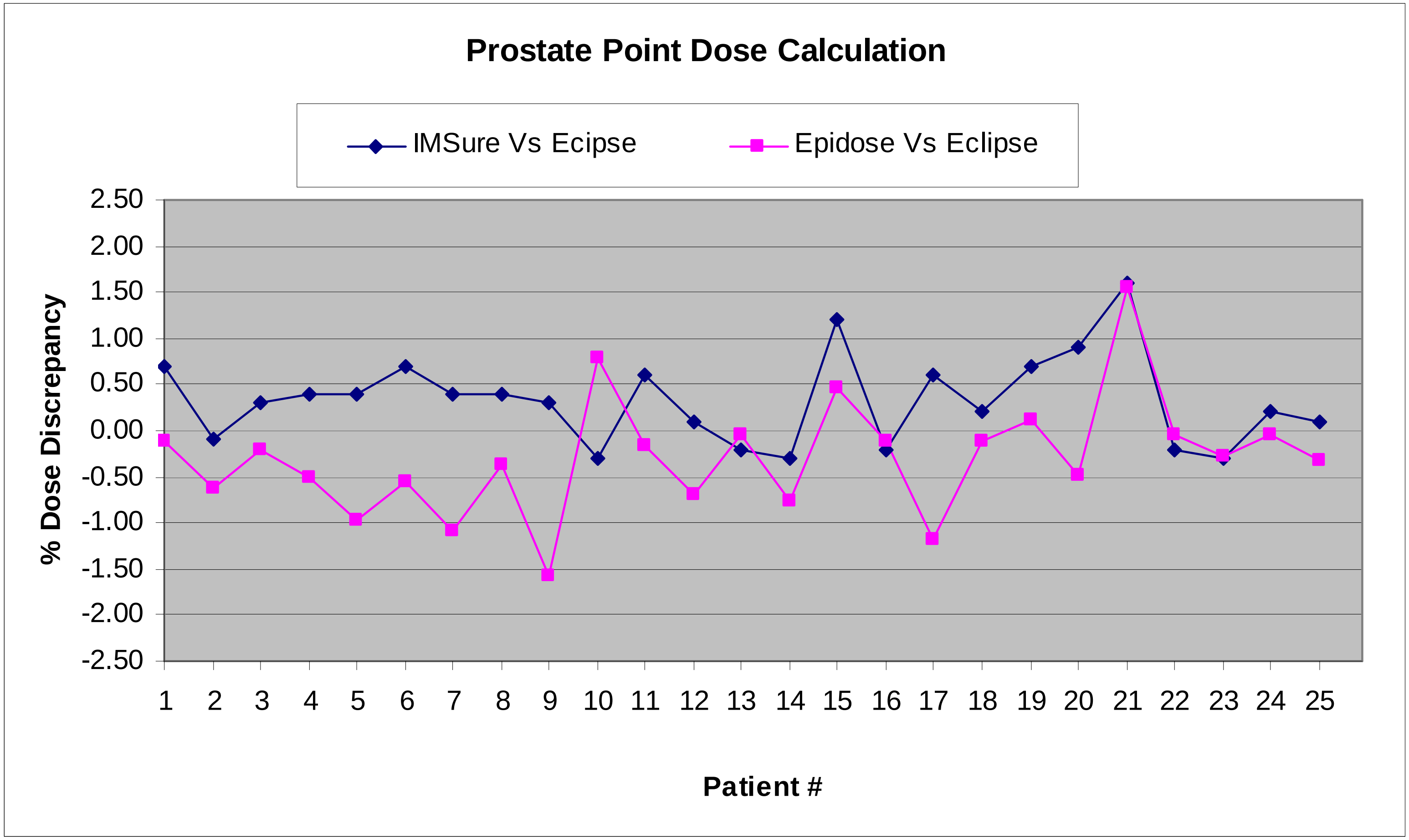

Figure 4: Point dose calculation in IMSure is shown compared to Eclipse and Epidose for the 25 prostate patients studied.

Conclusions

- This present study provided further evidence of the accuracy that can attained with IMSure, when compared to Eclipse and measurements for IMRT H&N and prostate plans.
- IMSure fluence map calculations were deemed sufficient at the 2% discrepancy level, with 95% passing score for most plans studied.
- IMSure point dose calculations were within +/- 2% range for H&N and +/-1% for prostate plans when compared to Eclipse and dose reconstruction based on portal imaging. Obtaining results beyond those limits warrants further evaluation involving measurements.

References

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