

Is the prediction of the gamma pass rate for IMRT QA measurements possible? A study including 250 patient cases

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PURPOSE

- IMRT QA results in large time and labor effort
- Idea of calculating risk of plan and prediction of pass rate (1,2)
- If works, selection of QA method based on risk is possible
- Own risk prediction algorithm (3)
- Question: does prediction algorithm work for clinical cases on larger scale?

METHOD

- 250 clinical patient cases
- Remeasurement for cases with high and low pass rates
- Measurements with PTW Octavius 4D
- Phantom plans by Raystation (Raysearch)
- Prediction algorithm:
 - DICOM RT file is analyzed
 - risk factor map based on field size, complexity, position, MU, MU rate, leaf speed/motion (Fig. 1)
 - 3D projection using a “risk” depth dose
 - Analyzation or export DICOM (risk)dose (Fig. 2)
 - Risk factors are 1.0 plus percentage risk
- Total risk index = No. of voxel gt 1.2 / total No. of voxel
- Normalization of doses to avoid absolute dose shifts, as these are not included in the model
- Gamma index calculation with 2mm, 2% local, 10% lower excursion limit
- Comparison done in different ways

RESULTS

- Remeasured cases show same pass rate.
- No significant correlation found
- Pass rate and risk ratio should be contrarily but are not (Fig. 3)
- Pass rate vs risk index no clear correlation (Fig. 5)
- Pass rate vs maximum risk at volume no clear correlation (Fig. 6)

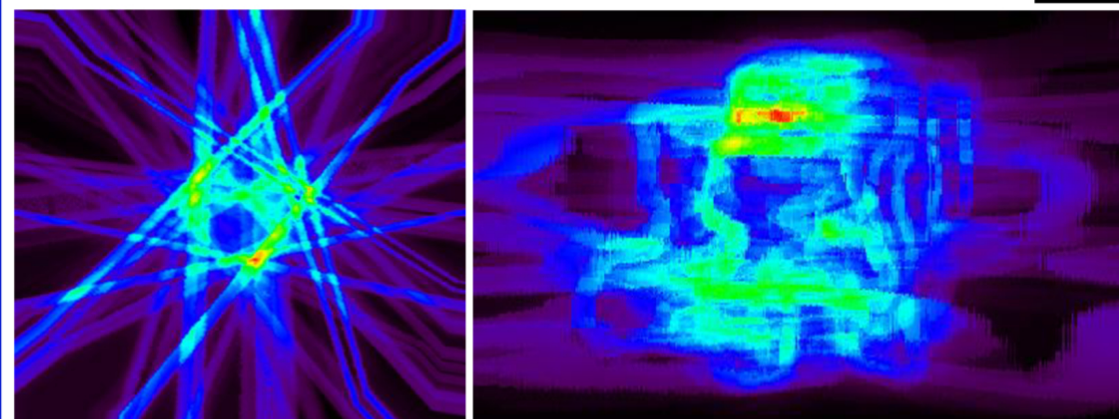


Fig. 2: Two views from the 3d projection of the risk factor distribution. Areas with high and low predicted risk can be seen.

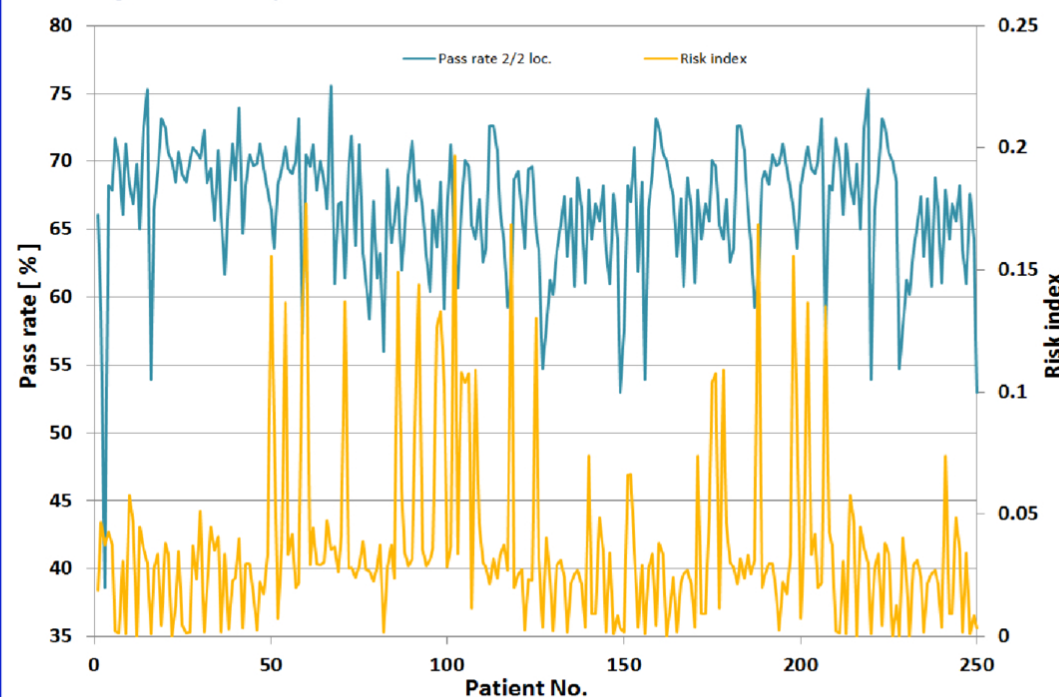


Fig. 3: Risk and Gamma pass rate for all cases. No clear connection.

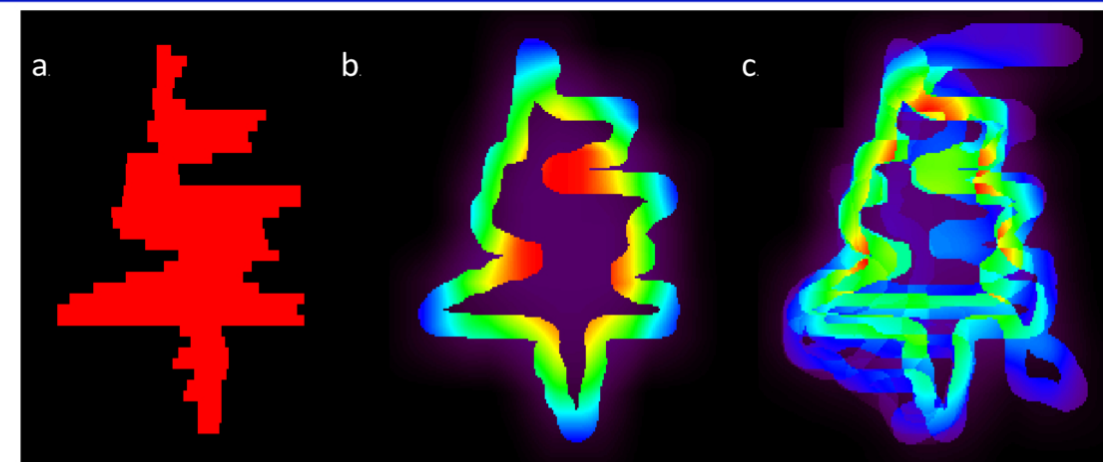


Fig. 1: Generation of a 2D risk map: a: MLC shape at a control point, b: colored uncertainty distribution single field, c: combined uncertainty map of a sequence field.

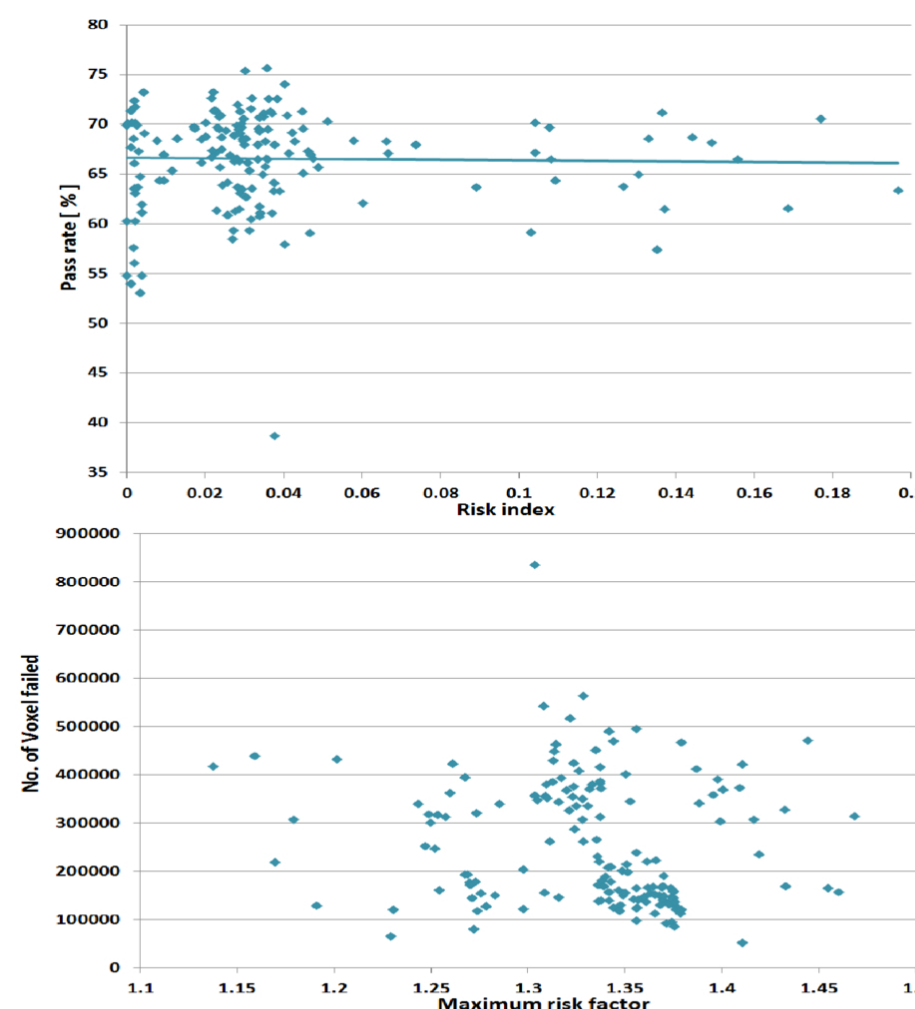


Fig. 4+5: Pass rate vs Risk index and Voxel failed vs maximum risk factor.

CONCLUSIONS

- Risk maps and Risk distribution are nice tool
 - Evaluation of field configurations
 - Evaluation of plans
 - To estimate total patient risk of wrong dosage
- Prediction of pass rates does not work
 - Model not working/wrong
 - Not included effects overlay/dominate prediction
- Risk factor predict a risk but it may not happen!

REFERENCES

- <1> Kim S, Jin H, Chung H, Palta J, Ye SJ. Potential uncertainty – information that was forgotten. In: Yi B, Ahn S and Choi E, eds. Proc. XIVth Int'l. Conf. on the Use of Computers in Radiation Therapy; 2004:139–141.
- <2> Masi L, Doro R, Favuzza V, Cipressi S, Livi L. Impact of plan parameters on the dosimetric accuracy of volumetric modulated arc therapy. Med Phys. 2013;40:071718.
- <3> Haering, P., Lang, C. and Splinter, M. (2016), SU-F-T-316: A Model to Deal with Dosimetric and Delivery Uncertainties in Radiotherapy Treatment Planning. Med. Phys., 43: 3535-3535.

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