Evaluation of a Novel Automation Software for Generating Field-In-Field Plans for Various Treatment Sites

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INTRODUCTION

Traditional Field-in-Field (FiF) planning involves the manual generation of an open field with hot spot volume-blocked subfields, that are merged to create one treatment field. This technique results in a reduction of the overall maximum dose and improved control in dose homogeneity.[1] EZFluence, an embedded script in the Varian Eclipse Treatment Planning System (TPS), automates the FiF process. Through optimization parameters chosen by the user, such as maximum dose or normalization value, maximum number of segments, and automated creation of a planning target volume (PTV), the software generates the subfields along with multiple plans for review. An optimal plan, based on dose volume histogram (DVH) statistics and associated visualization of the dose distribution, is then selected. The segments for the FiF are then built and sent to Eclipse for a final calculation and review by the planner.

AIM

Comparison study of traditional Field-in-Field (FiF) treatment plans to an automated approach using Radformation's software, EZFluence.

METHOD

A multi-institutional study between the Texas Oncology San Antonio and Rio Grande Valley regional radiation oncology treatment centers was performed to compare traditional FiF treatment planning with an automated technique using EZFluence. Accumulated data was used to assess software feasibility, time management, and plan quality.
This study compared 55 previously treated, traditional FiF breast, whole brain, and rectum treatment plans with plans created using EZFluence on the Eclipse v15.5 TPS. Beam configurations utilized energies of 6MV, 10MV, 18MV and mixed energy fields of 6/18MV with four different linear accelerators: two Varian TrueBeams and two Varian C-Series 21iX units.

Comparisons to the traditionally planned prescription dose coverage, maximum dose to the target, normal tissue dose tolerances, and the total monitor units (MUs) of each field were made with Radformation's ClearCheck. The time required to create an EZFluence plan, subfield merging, and normalization was recorded. Plans were validated and verified for accuracy with LifeLine's RadCalc® 2nd check software and Sun Nuclear Corporation's (SNC) MapCHECK®2 2D array.

RESULTS

EZFluence produced comparable plans in a relatively shorter time. When normalized to produce the same coverage of the original plan, the dose distribution, hotspot and dose to normal tissue structures were on the average within 1% of the original plan. Total MUs increased, on average, 4.5% (13 MUs). Average hotspot to homogenous plans was 106%. RadCalc® was within 5% and MapCHECK ® 2 demonstrated agreement of a passing rate of 95% (using 2%/2cm/10). Average time commitment for the creation of FiF plans through traditional steps was 10-20 minutes. With EZ fluence, time to create FiFs was greatly reduced to 4-9 minutes.

Below is an example of a left breast with tangent fields. A comparison of the target coverage and normal tissue constraints were evaluated using ClearCheck (Table 1). The EZFluence plan was normalized to give the same coverage as seen in the DVH (Figure 2). The coverage is similar (Figures 2 and 3).

Priority	Structure Template	Structure Plan	Type	Prescription	Constraint	Goal	EZE20_FiF	1-L Breast	Difference	Pass/Fail
1	Tumor Bed	Tumor Bed	Target	**Lt Breast: 4256cGy**	(Rx Dose coverage) V100% ≥	95-90%	98.222%	98.258%	-0.036	✓
2	Tumor Bed	Tumor Bed	Target	**Lt Breast: 4256cGy**	(Hot Spot: 110-120%) Max ≤	110-120%	106.209%	106.015%	-1.806	✓
3	Heart	Heart	OAR		(QUANTEC) V2270cGy ≤	5%	0.424%	0.426%	-0.002	✓
4	Ipsilateral Lung	Lung_L	OAR		(QUANTEC) V450cGy ≤	25%	21.375%	20.926%	0.449	✓
5	Ipsilateral Lung	Lung_L	OAR		(QUANTEC) V1820cGy ≤	10%	7.829%	7.797%	0.032	✓

Table 1. Target coverage and normal tissue constraints comparison example for the left breast (42.56Gy in 16 fractions).

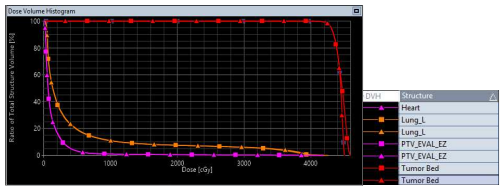

Figure 1. DVH comparison of the EZFluence plan (triangles) and original FiF traditional left tangent breast plan (squares). EZFluence plan is normalized to give the same coverage as seen in the DVH (42.56Gy in 16 fractions).

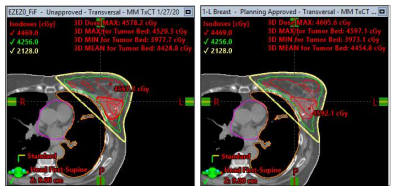

Figure 2. Comparison of EZFluence plan (left) and original FiF traditional left tangent breast plan (right). Axial view.

RESULTS (CON'T)

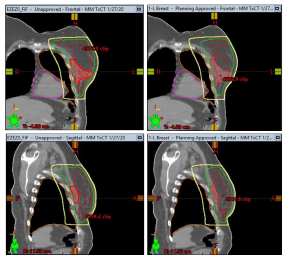

Figure 4. Comparison of EZFluence plan (left) and original FiF traditional left tangent breast plan (right). Axial view.

Independent dosimetric calculations of forty-eight patient plans (166 fields) were verified using RadCalc®. Forty-eight patients were evaluated, and the majority passed with a MU- and dose-difference of less than 5%. Five of the forty-eight patients (11 fields) had differences that exceeded 5%, with a maximum of 6.5%.

Forty-eight MapCHECK®2 patient QAs were performed. The average percent of points passing with a dose threshold of 10%, 2% dose difference and 2mm distance to agreement (DTA) was 98.1 ± 3.0% for 152 fields. An average of 98.7 ± 0.9% pass rate was obtained for 14 fields using the 3% dose difference and 3mm DTA.

Of the 23 plans created from the traditional approach and assessed for time, an average of 20.1 minutes was needed to complete each plan. The average EZFluence planning time for the same cases was 8.7 minutes. Feedback received from the medical dosimetrists indicated all but 2 of the EZFluence cases were of equal subjective plan quality to the traditional planning method. The times to create FiF plans using both approaches are shown in Figure 4.

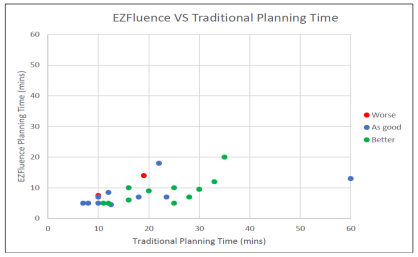

Figure 4. The planning time using EZFluence and traditional methods. In all 23 cases, EZFluence took less time than the traditional FiF method. In all but two cases, the EZFluence plan was clinically good or better than the plan created traditionally.

CONCLUSIONS

EZFluence produced comparable plans in a relatively shorter timeframe. When normalized to produce the same coverage of the traditionally designed FiF plan, the dose distribution, hot spot, and dose to normal tissue structures were within about 1% of the original plan. Total plan monitor unit increase averaged 4.5% (13 MUs). The time commitment for the creation of Field-in-Fields through traditional steps was on average 20 minutes, compared to an average time commitment of 9 minutes for EZFluence, although this time decreased through familiarity with the system.

Assessment of plan accuracy in dose and monitor units with RadCalc® confirmed < 5% agreement in 93% (51 of 55) of the patient studies. Apart from 4 treatment plans, MapCHECK®2 demonstrated an average passing rate agreement of 98.1% with a 10% threshold, 2% dose difference, and 2.0mm distance to agreement. The two verification and validation tools used in this study confirm the accuracy and feasibility of EZFluence FiF implementation within an institution. Through the addition of parameter standardization, the EZFluence workflow provides improved efficiency without compromise in plan quality.

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REFERENCES

1. N. Fournier-Bidoz, et. al. Technique alternatives for breast radiation oncology: Conventional radiation therapy to tomotherapy. J Med Phys. 2009; 24(3): 149-152.

CONTACT INFORMATION

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