Comparison of Compensator-IMRT and Segmental MLC-IMRT Techniques: A Retrospective Study on Treatment Time and Monitor Units in Clinical Application

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INTRODUCTION

Compensators have been successfully used clinically for dose-optimized IMRT treatment at the University of North Carolina at Chapel Hill since 1996. Today this valuable alternative IMRT delivery technique has been implemented in many cancer centers. There is a common conception that the manual compensator-IMRT treatment is much slower than the automated MLC-based IMRT delivery. Our years of experience in both the compensator-based and the segmental MLC-based IMRT (Siemens) indicated otherwise. In this retrospective study we compared the total monitor unit and the treatment delivery time in daily treatment using data stored in IMPAC R&V system for 150 randomly selected clinical IMRT cases. We also analyzed two components of the treatment time: the total monitor units per IMRT treatment and the time elapsed between treatment fields for both type of IMRT treatments.

CONCLUSION

Retrospective study of 150 clinical cases shows that the treatment time defined as time elapsed between the first field beam ON and the last field beam OFF for compensator-IMRT treatment is generally 50 to 100% faster than for Siemens segmental-IMRT treatment (Fig. 2). The average time elapsed between two fields (when therapists go in the treatment room and exchange compensators for compensator-IMRT cases) is no more than segmental MLC-IMRT treatments (Fig. 1). The compensator-IMRT in general requires similar or fewer monitor units compared to the MLC-IMRT technique (Fig. 3).

The study is based on older generation Siemens accelerators, which is reportedly ~30% slower than newer generation accelerators for IMRT.

METHODS AND MATERIALS

One hundred fifty (150) randomly-selected IMRT cases treated in our department since 2001 were used in the retrospective study. Most of the 7-9 fields per treatment cases, however, are treated in the last two years. The IMRT treatments were either compensator-IMRT or segmental MLC-IMRT on one of our three Siemens accelerators (2 Primus and 1 MD2). IMRT treatment planning was done on our in-house TPS PLanUNC using the same dose optimization engine for both IMRT delivery techniques. For compensator-IMRT, the high-resolution intensity maps are directly converted into compensator files for fabrication; for segmental MLC-IMRT the maps are first truncated into discrete maps and then MLC segments are generated using IMMAXX algorithm from Siemens.

The time record in LANTIS/IMPAC record & verify system for each of the IMRT patients in 5 daily treatments are analyzed and the average time is used. Data from days when port films are taken are excluded in the analysis. The time data is extracted from IMPAC database using a Crystal Report program that gives the starting time of each field/segment with time resolution of seconds. The finishing time for each field/segment is computed using the given treatment monitor units used and the monitor unit rate. The treatment time, *defined as the time elapsed between the beam-ON of the first field/segment and the beam-OFF of the last field/segment of the treatment* (single-isocenter only), is compared between the compensator-IMRT and segmental MLC-IMRT treatments. We also analyzed the time elapsed between the treatment fields - time for MLC shaping, gantry motion, compensator exchange, table kick-out, patient specific care, and other tasks therapists need to do between treatment fields in clinical treatment.

Q: Is the automated segmental MLC-IMRT faster than the manual compensator-IMRT clinical treatment?

A: No, this retrospective study showed otherwise.

RESULTS

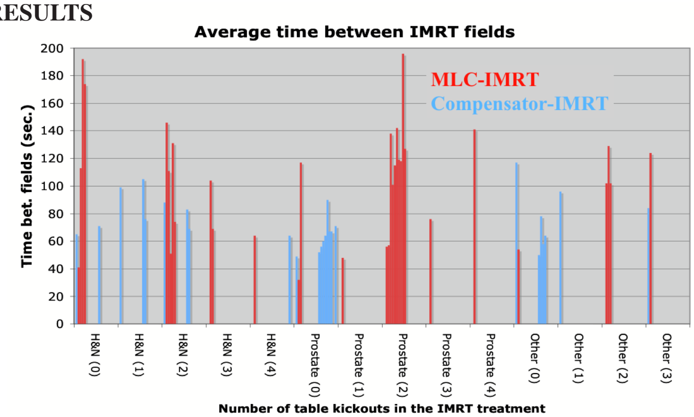

Figure 1 (above) shows the average time elapsed between two treatment fields in five days for 57 IMRT treatments recorded in IMPAC R&V system. The data is presented individually for different treatment sites (H&N, prostate, or other) and the number of manual table kick-outs. The data variation is significant which is likely due to the specific level of care each patient needed. However, the data shows clearly that, contrary to common belief, the manual compensator-IMRT treatments did not use more time than the automated MLC-IMRT treatment between treatment fields in real clinical situations.

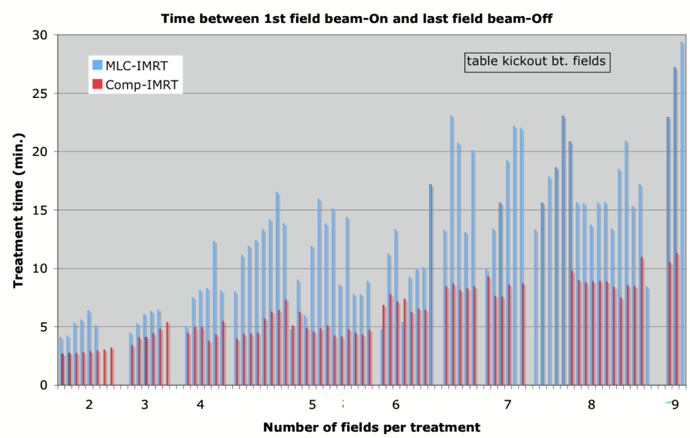

Figure 2 (above) shows the five-day average treatment time, defined as the time elapsed between the first field/segment beam-ON and the last field/segment beam-OFF. Some (not all) of the treatments with "table kick" field(s) are labeled. Each data point is a five-day average of a clinical IMRT treatment. The data show that compensator-IMRT is about 50 to more than 100% faster than segmental MLC-IMRT in actual clinical application. Furthermore, the increase in treatment time with the number of fields in the treatment for compensator-IMRT treatments is much less than for segmental MLC-IMRT treatments. The data include variation in fractional dose and MU rate.

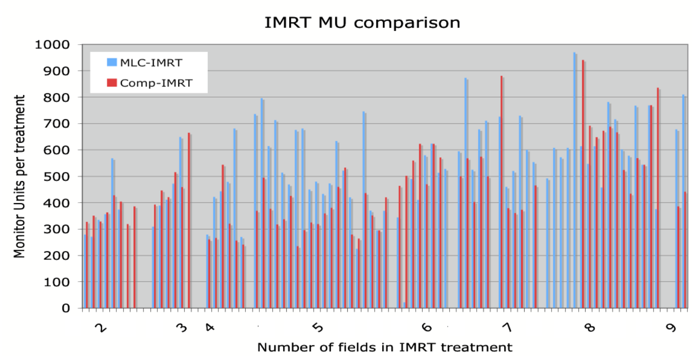

Figure 3 (above) shows the total monitor units (MUs) per IMRT treatment as a function of number of fields in the IMRT treatment. The data shows that the MU difference between compensator-IMRT and segmental MLC-IMRT is not significant. Although the trend is for MLC-IMRT treatments to require more MUs, compensator-IMRT treatment (one example in the 7-field group) can occasionally require more MUs than an MLC-IMRT plan.

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