CHAPTER 6

CONCLUSIONS AND FUTURE WORK

6.1 Compensator based IMRT for head and neck cancers

Our clinical experience with cIMRT clearly indicates its usefulness in terms of target coverage and organ at risk sparing. Not only our results were comparable to other studies using compensator, but also they were comparable to studies using MLC based IMRT in terms of achieving dosimetric parameters (Lee et al 2003). Though with limitation of intensity modulation because of limited thickness and density of compensator blocks, our results were within acceptable limits with slightly higher parotid doses. The manufacturing of compensator is cumbersome but it is a one time job followed by easy treatment delivery and simple QA program high monitor unit efficiency, less beam on time compared to other IMRT treatment delivery technique. This technology to deliver IMRT with compensators is quite mature, and can be applied to larger number of patient population with different type of tumor.

6.2 Intensity modulated radiotherapy quality assurance using MatriXX

We have found MatriXX to be energy and dose rate independent. The minimum read out time is 20 millisecond, which allows us to measure and analyze dynamic processes like dynamic IMRT, start-up process of the linear accelerator, build-up process of a virtual wedge. The disadvantage of MartiXX for IMRT QA is the limited resolution, resulting in limited sensitivity to MLC failures. MartiXX is a useful device
for IMRT pre treatment QA as it is time saving, efficient, easy to use and it can be used for both relative and absolute dose measurements.

6.3 Influence of photon energy on intensity modulated radiotherapy plans

The study was a comparative dosimetric evaluation of 6 MV and 15 MV photon beams IMRT plans for Ca Cx. We found that 6MV plans produce relatively less hot spots than 15 MV plans though the clinical impact of these dosimetric improvements remain unanswered. Our results revealed that, there is no clinical advantage of 15MV over 6MV when comparing the target coverage and normal tissue sparing. In theory, the increased treatment time, with 6 MV photons, can be compensated by increasing the dose rate and number of MUs can be reduced by smoothing the fluence without reducing the quality of plan, though the ratio of MUs remains same for 6 MV and 15 MV plans. New modality such as volumetric intensity modulated radiotherapy has the potential to reduce the MUs and treatment time to less than two minute (Cozzi L et al, 2008). Our study has shown the feasibility of achieving the desired dose distribution with 6 MV photons. We conclude that 6 MV photon energy is a good choice for Ca Cx IMRT, if a proper inverse planning technique is employed.

6.4 Clinical results of compensator based intensity modulated radiotherapy for head and neck cancer

Our target selection and delineation approaches are validated with no recurrences in this volume. Total treatment time and $V_{100\%}$ for CTV1PTV are significant independent predictors of locoregional relapse and can be fitted into a model to predict the decrease in hazard for failure. A larger dataset and longer follow up is required to validate these results.
With 61.4% of the patients having T3 or T4 lesions, majority of failures in this study lie within the CTV1PTV volumes. The locoregional control rate of 60.1% at 3 years can possibly be improved by addressing tumour biology.

6.5 Future work

We have shown in our study that the cIMRT is a feasible approach to deliver highly conformal and modulated treatment to patients. This technology can be extended to Co-60 based treatment machine resulting in further reduction in cost of cIMRT delivery. To implement Co-60 based cIMRT source modeling and scatter should be included in dose calculations.

We have shown that MatriXX can be used for IMRT dose verification on routine basis. The special resolution of MatriXX is limited which makes it difficult to analyze with sub-millimeter accuracy. We would suggest developing a high resolution device which doesn’t need lot of warm-up time and frequent calibration and it should be dose and dose rate independent.

We have shown in our study that a low energy beam can be used to produce clinically acceptable plans. We suggest including neutron dose contribution in patient dose either by direct measurement or MC simulation in case of high energy photon beam.

We have observed in our study that, in some case, in spite of delivering prescribed radiation dose to tumors, it fails to control the disease. The probable reason of failure could be hypoxia, inaccurate tumor delineation, radio resistance tumor or biology of the tumor. We suggest a biologically optimize treatment model which includes equivalent uniform dose (EUD), NTCP and TCP. Biological and molecular imaging would further improve the tumor visualization and delineation leading to better tumor cure and control rate.