Purpose:
Volumetric modulated arc therapy (VMAT) is a favored modality for SRS/SBRT treatment due to the efficiency in delivery and high conformality to targets achievable by this technique. Due to the dynamic characteristics of the MLC movement throughout the delivery process, tolerance is necessary in the system configuration for the deviation of MLC leaf position from the planned position. This work examines the characteristics of the MLC positioning errors in VMAT delivery.

Methods:
Five RapidArc fields with a mean MU=892 planned for SBRT lung cases were selected for this study. Each field was delivered 8 times using a Varian Trilogy machine. The MLC leaf positions were recorded at 50ms intervals by the MLC controller into the system dynalog files. The analysis of the dynalog files yields the statistics of the MLC position error and leaf bank gap error. The cumulative distribution functions (CDF) for the errors were calculated. These distribution functions were compared with the configured limit of 2 mm at the isocenter for dynamic leaf tolerance.

Results:
The distribution function of the leaf positioning error peaked at 0.5mm for each delivery. No violation on the system limitation was observed. The standard deviation from repeated delivery of the same field is very small. For all the fields, 90%, 95%, and 99% of the leaf positioning errors (E90, E95, E98) are within 0.50, 0.69, and 0.94 mm. The leaf gap error has similar overall characteristics as the leaf positioning error. E90, E95, E98 for the gap errors are respectively 0.69, 0.87 and 1.3 mm.

Conclusions:
The MLC leaf positioning errors are within the system tolerance throughout VMAT delivery. Cumulative distribution function is a useful method for analyzing these errors. The statistical characteristics and some key statistical parameters for the MLC positioning error and the leaf gap errors were obtained.