Purpose: To investigate the correlation between Multileaf Collimator (MLC) positional errors against its speed and dose rate during volumetric modulated arc therapy (VMAT) delivery by an Elekta Beam Modulator LINAC, using Am-Si EPID while MLCs were moving in a mathematically well defined velocity.

Methods: VMAT is delivered by the control points (CP). Each CP, is characterized by a definite aperture $\chi = f(\omega, dX_i / dt)$, a dose rate defined by monitor unit $M = f(\omega, dX_i / dt)$ ($\omega$ - gantry angular speed and $X_i$ position of ith MLC). The MLC motion can be written as an explicit function either of time only or of gantry angle and time $X_i = f(t)$ or $f(\omega, t)$. The MLCs were moved with linear, parabolic and elliptical velocity defined as a function of time. Beam delivery was interrupted at certain points and portal images were acquired and MLC positional error (MLCPE) was calculated.

Results: The velocity dependent MLCPE were evaluated for all combinations of discrete dose rates 35, 70, 140, 280, 560 MU/min and MLC speeds 0.5, 1, 1.5, 2 and 2.5 cm/sec. Maximum MLCPE is 1.59 mm for 2.5 cm/sec-70Mu/min. Mean MLCPE was 0.25 mm (SD 0.02). There was significant relation of MLC positional error with the velocity in 7th ($p=0.017$), 12th ($p=0.11$), 15th ($p=0.26$), 22nd($p=0.045$), 24th ($p=0.011$), 26th ($p=0.043$), 27th ($p=0.007$), 28th ($p=0.042$), 29th ($p=0.01$), 31st ($p=0.017$), 33rd ($p=0.01$), 34th ($p=0.008$), 35th ($p=0.030$), 36th ($p=0.035$), 37th ($p=0.042$), 39th ($p=0.046$), 40th ($p=0.017$) MLC's. where $p$ is probability coefficient. There was no association of dose rate with MLCPE. On sub group analysis we found MLCE was more correlated with velocity when dose rate was 35 MU/m with R2 value of 0.8 compared with other dose rates (70MU/min, 140MU/min, 280MU/min, 560MU/min).

Conclusions: MLCPE never exceeded clinically significant value of 2mm, showing a strong velocity dependency but no significant dose rate dependency.