Purpose:To use confidence limit dose volume histograms to evaluate the impact of residual systematic error during para-spinal stereotactic body radiotherapy (SBRT).

Methods:Retrospective analyses of the impact of residual systematic errors were performed for ten patients undergoing para-spinal SBRT. Residual random errors were modeled by convolving the planned dose with a Gaussian distribution (Stdev 1.5 mm). Residual systematic setup errors were assumed to be normally distributed with standard deviations from 1 to 4 mm and were modeled using a Monte Carlo (MC) simulation. During the MC simulation, it was assumed that actual systematic setup error would be kept to institution-defined thresholds which would equal one standard deviation. Confidence intervals were calculated by sorting the resulting MC DVHs according to a pre-selected critical dose or volume (e.g. D95). Dose was calculated with an in-house planning system and a grid spacing of 1mm.

Results:Mean (Stdev) planned cord/cauda D05 was 46.1% (11%) of the prescribed dose. Mean 5% and 95% confidence intervals were 100.8% and 117.0% of the planned D05 for a 1 mm residual error and 94.1% and 155.1% for 4 mm residual error. The expected cord/cauda D05 (i.e., mean over all confidence levels) for tumors partially surrounding these structures was generally within 5% of the planned dose and the 5% and 95% confidence limits were approximately 5% to 15% lower/higher than planned dose for systematic errors no more than 2 mm. For tumors surrounding the cord/cauda, D05 equaled or exceeded the planned dose, regardless of confidence level or magnitude of residual error and the expected cord/cauda D05 could exceed planned D05 by 10% or more.

Conclusions:Residual systematic error can result in clinically significant deviations between planned and actual dose particularly for patients with extensive disease. Such analyses can guide the level of treatment intervention required for individual patients.