Purpose:

The objective for this study is to systematically evaluate how the CTV to PTV margin should be created to compensate for setup error as a function of treatment site.

Methods:

A total of 1757 setup MVCT images were analyzed using the registration between the MVCT and planning KVCT images. Among them, 526 images were from patients with head and neck cancers; 342 were from thoracic site; 447 from upper abdomen and 442 from patients treated at pelvic region. The correction was shifts in 3 directions from setup with skin marks to final treatment position due to volumetric image registration. Registration was based on soft tissue anatomy when tumor was visible in both KVCT and MVCT. Otherwise, bony landmarks were used when tumors could not be identified.

Results:

The anterior to posterior (A/P) direction requires the smallest correction for all body sites. The percentage of treatment with < 3mm set-up correction in A/P direction was 82.4%-96.0% for all disease sites. In medial to lateral direction (M/L), that number was 51.5%-74.7%. The largest set-up correction occurred in the superior to inferior (S/I) direction. As a function of the body site, 68.6% of head and neck patient had <3mm shift in the S/I direction. However, that number dropped to 41.8%-42.5% and 31.9% for thoracic, upper abdomen and pelvic sites respectively. In addition, 48.0% of pelvic tumor required >5mm shift in the S/I direction. For thoracic and abdominal tumors, there were still 34.9% and 30.7% of the treatments where >5mm shift in the S/I direction was needed.

Conclusions:

Uniform expansion margins in all directions are often used in radiation oncology practice. Our study showed setup error was directionally dependent. Therefore, non-uniform margin should be applied. Smaller margin can be used in A/P while larger expansion needs to be given in the S/I direction.