Purpose: For the treatment of patients with lung cancer, internal target volume (ITV) is frequently determined by contouring of gross tumor volumes (GTV) on 10 phases of a four-dimensional computed tomography (4DCT) scan. This study investigated the possibility of generating ITV by using selective phases of a 4DCT scan.

Methods: The 4DCT scans of 20 patients with lung cancer were included in this study. GTVs were contoured on all 10 phases in Focal4D (CMS, St. Louis, MO). Different ITVs were derived by encompassing volumes of contours from selective phases. ITV10 was derived from contouring GTV on all 10 phases and served as the gold standard. All the other ITVs were smaller and within ITV10. The ratios of the volume of ITVs to ITV10 were calculated and used as a criterion to determine the similarity of ITVs to ITV10. ITV2 represented the ITV derived by using end of inhalation and end of exhalation (0%+50%). ITV3E was derived from contouring the three phases at end-inhalation, mid-exhalation, end-exhalation (0%+20%+50%). ITV3I was derived from contouring the three phases at end-inhalation, mid-inhalation, end-exhalation (0%+70%+50%). ITV4 was created by contouring the four phases at end-inhalation, mid-inhalation, end-exhalation, mid-exhalation (0%+20%+50%+70%). ITV6E was derived from contouring the six consecutive phases during exhalation (0%+10%+20%+30%+40%+50%). ITV6I was derived from contouring the six consecutive phases during inhalation (50%+60%+70%+80%+90%+0%).

Results: ITV6I showed excellent agreement with ITV10 (Volume ratio ITV6I/ITV10=0.975). ITV4 and ITV6E showed good agreement with ITV10 (ITV6E/ITV10=0.939, ITV4/ITV10=0.944). The volume ratio ITV3I/ITV10 and ITV3E/ITV10 was 0.927 and 0.906 respectively. ITV2 did not agree well with ITV10 (ITV2/ITV10 =0.888).

Conclusions: Contouring all phases during inhalation will give a good estimate of the internal target volume, while helping to minimize the clinical load and work time during treatment planning. However, the ITV will be underestimated if only contouring on two extreme phases.