Feasibility study of proton arc therapy for the treatment of para-aortic lymph node tumor.

1. Introduction
The purpose of the present study was to compare dosimetric properties of proton arc therapy (PAT) with those of intensity modulated radiation therapy (IMRT) and 3D conformal proton beam therapy (PBT) in the treatment of para-aortic lymph node tumor and to identify the limitations, if any, of these techniques. To compare dosimetric properties among treatment modalities, we used the various indices such as homogeneity index (HI), conformity index (CI), normal tissue complication probability (NTCP) and OED based on the analysis of dose-volume histograms (DVHs).

2. Materials and Methods:
IMRT, PBT and PAT plan method: Plans for IMRT and PBT were made based on conventional methods. Proton plans for PBT have been generated using a planning system developed specifically for the planning of proton treatments using the double scattering technique. The snout size of each patient was 100 mm and it was made from brass. Two to three beams were used and the angles of them were 0, 270, and 90 with ± 10° variation. PAT mode is not currently available in the treatment planning system. Therefore, it was simulated using many beams such as 48 beam ports with the interval of 5 degree from 250 ~ 120 degrees.

3. Results and Discussion:
The average doses delivered by PAT to the liver, kidney, small bowel, duodenum, stomach were 7.6%, 3%, 17.3%, 26.7%, and 14.4%, of the prescription dose (PD), respectively, which is higher than the doses delivered by IMRT (0.4%, 7.2%, 14.2%, 15.9%, and 12.8%, respectively) and PBT (4.9%, 0.5%, 14.12%, 16.1% 9.9%, respectively). The average homogeneity index and conformity index of tumor using PAT were 12.1 and 1.21, respectively which were much better than IMRT (21.5 and 1.47, respectively) and comparable to PBT (13.1 and 1.23, respectively). The result shows that both NTCP and OED of PAT are generally lower than IMRT and PBT.

4. Conclusion:
This study demonstrates that there is a potential role for proton arc therapy as an alternative to proton therapy when abdomen dose must be minimized. Although PAT is not available treatment in current time, it will be more efficient and safer treatment in the future with additional research and development for commercialization.