Purpose: For spot scanning proton therapy (SSPT), treatment plans generated using single field optimization (SFO) are more robust than plans generated with multi-field optimization (3D intensity modulated proton therapy). The purpose of this work is to present a single field (simultaneous) integrated boost (SFIB) technique for SSPT.

Methods: The SFIB plans were designed to deliver multiple level doses to multiple targets using SFO for each field. Dose constraints were used to achieve the target coverage and normal tissue sparing. Multiple SFO fields are normally used for each fraction of treatment. The total and fraction doses for each dose level were based on the current clinical practice using x-ray IMRT in our clinic. Fourteen patients, nine with brain lesions, one with spine lesions and four with prostate cancer, were treated with SSPT using SFIB. All patients were treated with two different dose levels, except the spine patient treated with three dose levels. All lesions were treated with two or three fields except the spine lesion treated with a single PA field.

Results: The SFIB creates more conformal dose distributions. Examples of dose distributions and results of quality assurance (QA) measurements will be presented. The applicability and logistics of SSPT using SFIB will be discussed.

Conclusions: Using SFO, we have successfully implemented a SFIB technique for SSPT and proved that we are not limited to create uniform dose within target volumes. Compared to the conventional sequential delivery, the SFIB technique offers advantages, including seamless treatment delivery and more efficient treatment planning and patient specific QA. Compared to IMPT, SFIB plans are more robust by definition and but less versatile. The biological benefits of SFIB could also be explored.