Purpose: To describe considerations in proton therapy immobilization and the effects which design elements have on the proton dose distribution.

Methods: Proton therapy has dose distribution advantages over photons through the Bragg peak. This high dose region and sharp distal fall off that produces no primary particle exit dose can be placed at any point within the patient leading to the use of fewer beams and lower integral doses. Proton patient immobilization needs to reduce patient motion to the largest extent feasible, as is the case with other radiation therapy modalities, but also needs to consider the effect of the immobilization device on the proton range and whether this is accurately reflected in the dose calculation.

Results: Our proton treatment center has treated patients with protons for over 20 years, and the development of effective immobilization methods has been an integral part of this experience. For the various anatomic sites, specific devices have been developed that position and immobilize the patient reproducibly and effectively. Attention was paid to minimal proton water equivalent thickness (WET) to minimize the effect on proton beam penumbra. The WET of each immobilization material has been well characterized and incorporated in the (CT-based) proton range calculation to minimize systematic errors in the proton range uncertainty. In our experience, proton immobilization devices should have beveled edges when possible to avoid edge effects that can drastically affect the depth of proton penetration. Effective use of internal immobilization, such as rectal balloons or breath holding, is also important to minimize ITV margins and suppress motion-related beam range uncertainties that are unique to proton therapy.

Conclusions: In proton therapy patient immobilization, additional considerations are needed to ensure that the immobilization device does not negatively impact the proton dose distribution and its uncertainty.