Proton therapy provides the planner with the unique characteristic of a finite range of treatment dosing. The Spread Out Bragg Peak (SOBP) of the proton beam can often deliver a uniform dose to the target regions with only two or three beams. This property can be used to limit integral dose to the patient while still providing uniform dosing to the target region. As a result of this distinctive control of the stopping point of the protons, large errors in the planned dose delivery can occur if the patient's anatomy or the patient's alignment at the time of treatment does not match that of simulation. Proton treatment planning systems include the exclusive parameters of range and modulation to control target coverage in conjunction with smearing to account for possible positional variances.

The familiar concepts of GTV, CTV and OAR's are shared between photon and proton planning strategies. The concept of PTV however takes on a more precise role in proton therapy since the magnitude of uncertainties varies with depth and must be determined in both the lateral aspect and depth aspect for each field. This leads to a field specific PTV that is particular to each treatment field. Although this concept is also true in photon planning, the usually large number of fields and the small magnitude of the uncertainties often allow this more literal definition to be ignored.

The acceleration process of protons produces a small pencil beam of protons into the treatment room. This pencil beam must be spread over the target region in one or more methods of treatment delivery, including active scattering, passive scattering (uniform scanning) and spot scanning. Each method has its own advantages and disadvantages in treatment delivery complexity and dosing properties. Spot scanning can provide the user with the additional capabilities of a more conformal proximal dose distributions and the possibility of intensity modulated proton therapy (IMPT).

Learning Objective

1. Understand the properties of clinical proton dose delivery
2. Describe some of the unique treatment planning tools and strategies used in proton therapy planning
3. Review target definition model when using charged particles
4. Understand the differences and potentials of scattering, uniform scanning and spot scanning treatment delivery systems.