We present a methodology for optimizing radiotherapy beam portals through the use of successive refinements using a “beamlet” concept. For this concept, we define a single beam as specifying a particular beam direction and associate with this beam a collection of “beamlets”. Beamlets can be individually weighted to form a non-uniform (or intensity modulated) beam portal. The main advantages of the beamlet concept over oft-reported optimization of intensities are that beamlet optimization occurs in dose space, rather than intensity space, and the concept can be used to make plan improvements through successive refinements. For a given beamlet, a convolution/superposition dose calculation is used to calculate the dose resulting from the primary fluence passing through the area of each beamlet . For optimization, the doses to a set of sample points within pre-specified regions of interest are computed for each beamlet. The weights to individual beamlets are then optimized using simulated-annealing to minimize a user-definable cost function. Applying a successive refinement strategy using beamlets may allow the optimized intensity distribution solution on a coarse grid to be approximated by a wedge with the wedge angle and orientation defined by the intensity gradient, while subdivision near high gradient regions such as the edge of the target projection can be used to determine geometrical edges for field shaping. The results of beamlet-based optimization will be shown for a number of clinical cases . *Work supported in part by* NIH *grant no.* P01-CA59827.