Purpose:
To demonstrate the first instance of the direct production of deliverable plans using multi-objective IMRT treatment planning.

Method and Materials:
Three clinical IMRT cases are studied: a pancreas, prostate, and brain. The research software ORBIT Workstation is used to create a database of Pareto optimal treatment plans. For each case, N+1 plans are generated, where N is the number of objective functions. N=6, 8, and 9 for the pancreas, prostate, and brain, respectively. The N+1 plans are the N anchor points solutions (each objective individually minimized) and a single equally weighted solution. For all runs, a minimum dose to the target of approximately 90% of Rx dose is used as a constraint to ensure that each plan has some target coverage. The resulting plan database is navigated with a graphical user interface that allows users to improve any objective by appropriately mixing the plans in the database in real time. The final averaged plan is then used as the input to a dose matching algorithm in ORBIT, which achieves that plan using direct machine parameter optimization (DMPO).

Results:
We find that the database of size N+1 is adequate to explore the treatment tradeoffs and select a treatment plan. The selected plan can be reproduced with DMPO, and in fact the normal tissue sparing is typically improved during this step.

Conclusion:
Since smooth navigation of Pareto optimal plans involves averaging plans, navigation can be done only before the plans are sequenced. We demonstrate the success of a two step approach, where first plans are generated and navigated in beamlet space and then the selected mixed plan is made deliverable by a DMPO dose mimicking algorithm.

Conflict of Interest (only if applicable):
Work done in collaboration with RaySearch Laboratories.