In the previous video, we saw that the mandible, or jawbone, received the highest dose out of all of the critical structures.

The mean mandible dose was 11.3 gray.

So how can we reduce this?

One approach is to modify our objective function.

Our current objective is to minimize the sum of the total dose to each critical structure.

So we're minimizing the sum of the total dose to the brain, plus the total dose to the brain stem, plus a total dose to the spinal cord, plus the total dose to the parotid glands, plus the total dose to the mandible.

We could instead change our objective to make the total dose to the mandible more important.

This can be done by weighting the term for the mandible.

By giving the mandible dose a weight of 10, the total dose to the mandible becomes 10 times more important in our objective than the total dose to the other critical structures.

If we solve our problem with this new objective, we get the solution shown in this figure.

The dose to the tumor, shown as the red line, does not change.

It still stays within the constraints we've defined.

For each of the critical structures, the solution with the previous objective is shown as a dotted line, and the new solution with the weighted objective is shown as a solid line.

We can see that the dose to the mandible, shown in blue, has significantly decreased by adding a weight in the objective.

However, the dose to other critical structures has increased, especially to the parotid glands, shown in black, and to the spinal cord, shown in green.

This shows how you can modify the objective to capture different trade-offs that might be desirable to different decision-makers or for different patients.

Another way to explore trade-offs is to modify the constraints.

For example, by relaxing the mandible maximum dose constraint or by allowing the maximum dose to the

mandible to be higher, we may improve our total healthy tissue dose.

We would like to know how much the objective changes for different constraints.

This can be answered by looking at the shadow prices of the constraints.

Recall that we have a constraint limiting the total dose for each voxel in each critical structure.

This table shows the highest shadow price for any one voxel in each critical structure.

The parotid glands and the brain stem have shadow prices of 0.

This means that we're not even giving the maximum amount of radiation allowed to these structures, so modifying the constraints is not beneficial.

The spinal cord has a shadow price of 96.911.

This means that by increasing the radiation to one voxel of the spinal cord by one unit, we can decrease the total radiation to other critical structures by 96.9 units.

The mandible has the highest shadow price of 7,399.72.

So if a slight increase in the mandible dose to a single voxel is acceptable, the total healthy tissue dose can be reduced.

Keep in mind that this is the total reduction across all voxels in the objective.

We've seen in this video that by modifying the formulation, both the objective and the constraints, we can explore different trade-offs in our problem.