# **Optimization Constraints**

## **About Constraints**

*Constraints* can be set in multiple levels (*Plan, Fraction Group, Beam Set Group*) and they will function differently in each level. Note all constraints are considered "hard limits"- constraints that must be achieved. *Constraints* are what drive the feasibility calculation- whether the plan is achievable. *Constraints* at the *Plan* level are applied to the total dose across all beams. *Constraints* at the *Fraction Group* level apply to the total dose across all beams in the Fraction Group. Constraints at the *Beam Set Group* level are split evenly and applied individually to each Beam Set. In other words, the *Constraint* dose is divided by the *Beam Sets* in the *Beam Set Group*, so that both SFO and IMPT can be achieved (see Fraction Groups). The following will provide a walk through of the different levels and how constraints work at each one.

The following constraint types are available. Note certain constraints are available only for *Target* type structures.

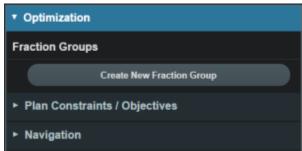
- Min: The minimum dose the structure must receive
- Max: The maximum dose the structure must receive
- Min Mean: The minimum mean dose a structure must receive
  - $\circ\,$  This will drive the dose up across the structure
- Max Mean: The maximum mean dose a structure must receive • This will limit the mean dose across the structure
- The user can choose to apply one of these constraints or multiple constraints to the structure

### **Working with Constraints**

#### **Working with Fraction Group Constraints**

Constraints at the Fraction Group level apply to the total dose across all beams in the Fraction Group

1. Select the *Fraction Group* if it has been created or create a new by selecting *Create New Fraction Group* 



2. Choose the target, the phase and number of fractions to be treated within this Fraction Group

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| Create Fraction G                     | roup                       |              |           |  |
|---------------------------------------|----------------------------|--------------|-----------|--|
| Color:                                |                            | • • • • •    | •••       |  |
| Description:                          |                            |              |           |  |
| Phase:                                | orig walkthro              | ugh 🔻        |           |  |
| # of Fractions:<br>Group Constraints: | 4 Total: 44, Remaining: 44 |              |           |  |
| Group Constraints.                    | PTV_7920 X                 |              |           |  |
|                                       | Min:                       | 75           | су(яве) 🗙 |  |
|                                       | Max:                       | 83           | су(яве) 🗙 |  |
|                                       | Min Mean:                  | add statemen |           |  |
|                                       | Max Mean:                  | add statemen |           |  |
|                                       | Add Structur               | e 🔻          |           |  |
| Target List                           |                            |              |           |  |
|                                       | Add T                      | arget        |           |  |

- 3. Choose from the drop down the structure or structures to which constraints should be added
- 4. Define what constraint(s) should be applied to each structure by choosing the constraint and entering the dose

| Edit Fraction Grou | ıp                          |                          |  |  |  |
|--------------------|-----------------------------|--------------------------|--|--|--|
| Color:             |                             |                          |  |  |  |
| Description:       |                             |                          |  |  |  |
| Phase:             | orig walkthro               | ugh 🔻                    |  |  |  |
| # of Fractions:    | 44                          | Total: 44, Remaining: 44 |  |  |  |
| Group Constraints: | Group Constraints: PTV_7920 |                          |  |  |  |
|                    | Min:                        | add statement            |  |  |  |
|                    | Max:                        | 73 Gy(RBE) 🗙             |  |  |  |
|                    | Min Mean:                   | add statement            |  |  |  |
|                    | Max Mean:                   | add statement            |  |  |  |
|                    | Add Structur                | e 🔻                      |  |  |  |
| Target List        |                             |                          |  |  |  |
|                    | Add 1                       | farget                   |  |  |  |
|                    |                             |                          |  |  |  |

- 5. Once the constraints are set in the *Fraction Group* the user will create *Beam Set Groups* and assign *Constraints*
- 6. The assigned constraint doses will be divided evenly among the Beam Sets in the Beam Set Group

| Tar | get List     |  |
|-----|--------------|--|
|     |              | Add Target   |
|     | Target       | PTV_7920 🔻   |
|     | Beam Sets:   |  |
|     |              | b1 - G90 C0; 12 cm; no shifter; X<br>add beam  |
|     |              | <ul> <li>beam set remove</li> </ul>  |
|     |              | b2 - G270 C0; 12 cm; no shifter; 🗙   |
|     |              | add beam  add be |
|     | Constraints: | PTV_7920 X   |
|     |              | Min: 70 судже) 🗙   |
|     |              | Max: add statement   |
|     |              | Min Mean: add statement<br>Max Mean: add statement   |
|     |              | Add Structure  |
|     |              | Done Cancel  |
|     |              |  |

#### **Working with Plan Constraints**

Constraints at the Plan level are applied to the total dose across all beams.

1. Open the *Constraint* sub block contained in the *Plan Constraints/Objectives* block and choose the *Edit*button.



2. Choose from the drop down the structure or structures to which constraints should be added

| <ul> <li>Optimization</li> </ul>    |           |
|-------------------------------------|-----------|
| Fraction Groups                     |           |
| f1 - fractions: 44                  |           |
|                                     |           |
| Create New Fractio                  | n Group   |
| Plan Constraints / Objectives       |           |
| Constraints                         |           |
| Add Structure                       |           |
| target                              | OK Cancel |
| PTV_7520                            |           |
| OAR<br>Skin                         |           |
| Bladder                             |           |
| Prostate                            |           |
| Rectum                              | Edt       |
| other                               |           |
| F 2cm                               |           |
| n Bladder neck                      |           |
| G Bowel                             |           |
| Left Femoral Hea                    |           |
| Neurovascular Bu                    |           |
| Right Femoral He                    |           |
| Seminal Vesicles                    |           |
| Testes                              |           |
| Urethra                             |           |
| penile bulb                         |           |
| Create                              |           |
| Create a new structure to use here. |           |

3. Define what constraint(s) should be applied to each structure by choosing the constraint and entering the dose

| <ul> <li>Plan Constraints / Objectives</li> </ul> |    |         |   |   |
|---|----|---------|---|---|
| Constraints                                       |    |         |   |   |
| PTV_792   | 20 |         |   | × |
| Min:  | 75 | Gy(RBE) | × |   |
| Max:  | 84 | Gy(RBE) | × |   |
| Min Mean:   |    |         |   |   |
| Max Mean:   |    |         |   |   |
|   |    |         |   |   |

4. Follow this and enter the constraints for all applicable structures.

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| <ul> <li>Plan Constraints / Objectives</li> </ul> |    |         |   |           |
|---|----|---------|---|-----------|
| Constraints                                       |    |         |   |           |
| PTV_792   |    |         |   | ×         |
| Min:  | 75 | Gy(RDE) | × |           |
| Max:  | 84 | Gy(RBE) | × |           |
| Min Mean:   |    |         |   |           |
| Max Mean:   |    |         |   |           |
| Rectum  |    |         |   | ×         |
| Max:  |    |         |   |           |
| Max Mean:   | 49 | Gy(RBE) | × |           |
| Bladder   |    |         |   | ×         |
| Max:  |    |         |   |           |
| Max Mean:   | 45 | Gy(RBE) | × |           |
| Add Structure                                     | •  |         |   |           |
|   |    |         |   | OK Cancel |

- 5. When finished click the orange OK button.
- 6. Once all the Constraints have been set the user can either start the Feasibility or move on to defining the Objectives

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