The Utility of Off-cord Arc Beams in RapidArc Planning for Head/Neck Cancers

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Purpose

To investigate the effects of utilizing off-cord arc beams in head/neck RapidArc planning.

45-degree collimator degree arc beam

Off-cord arc beam, the inner x-jaw is closed at 5mm away from the cord
Advantage & disadvantage of utilizing off-cord arcs

Advantage: Off-cord arcs contribute neither direct nor leakage dose to the cord. The cord dose constraint becomes more easily to achieve.

Disadvantage:
1. The inner X jaw does not comply to the shape of the cord for the full arc rotation.
2. Off-cord arcs have shorter field widths. With smaller MLC aperture, higher monitor units are needed
The inner X jaw does not comply to the shape of the cord
Off-cord arcs have smaller MLC aperture

\[ 2 \times \text{Aperture-Area (off-cord arc)} = \text{Aperture-Area (open arc)} \]
A comparison study to combine off-cord arcs and open arcs

- Five patients with head/neck cancer receive RapidArc treatments for primary PTV and 1-2 concurrent boost PTV(s).
- For each patient, three RapidArc plans are generated in Eclipse using the same dose constraints and priority weights,
  - Including
    - one “2+1” plan: 2 off-cord arcs + 1 open arc
    - one “1+2” plan: 1 off-cord arc + 2 open arcs
    - one “0+3” plan: 3 open arcs
Cord Protection: Plan(“1+2”) > Plan(“2+1”) > Plan(“0+3”).
DVH comparison for Patient A

Dose Conformality: Plan("1+2") > Plan("2+1") > Plan("0+3").
DVH comparison for Patient A

Dose Conformality: Plan("1+2") > Plan("2+1") > Plan("0+3").
Dose Conformality: Plan("1+2") > Plan("2+1") ≈ Plan("0+3").
Cord Protection: Plan(“2+1”) > Plan(“0+3”) > Plan(“1+2”).
Dose Conformality: Plan("2+1") > Plan("0+3") > Plan("1+2").
Dose Conformality: Plan(“2+1”) > Plan(“0+3”) > Plan(“1+2”).
Results

1. With higher MU and more MLC modulation, the “1+2” and “2+1” plans outperform the “0+3” plan in terms of cord protection and PTV coverage.

2. However the “2+1” plan is always the best even thought it always has the highest MU.
MU comparison of three RapidArc plans

Monitor Unit

- Patient A
- Patient B
- Patient C
- Patient D
- Patient E

Legend:
- "2+1" plan
- "1+2" plan
- "0+3" plan
Conclusion

Utilizing off-cord arc beams causes higher MU number and more MLC modulation in head/neck RapidArc planning.