Maintain the Quality of Treatment Planning for Time-Constraint Cases

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Session: Optimizing the Treatment Planning Process

Project Management Triangle

Cost: no. plans per planner per day
Time: no. of days
Product: no. of plans per planner

Project Constraints

- For the same Scope,
  \[ \text{Quality} = \text{Time} \times \text{Resources} \]
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  \[ \text{Scope} = \text{Time} \times \text{Resources} \]
- The values are not unbounded: “one planner can finish one plan in one day” doesn’t mean “four planners can finish a plan in a quarter day.”
Time-Constraint Cases in RT

- **Time constraint:** planning time < 2 days
- **Cases might include:**
  - SRS/SBRT using complex IMRT/3D plans
  - Chemo RT: must start at the same time as chemo
  - Emergency palliation using simple 3D plans.

The scope must be reduced for time-constraint cases

- **We want the highest quality**
- **For the same quality,** $\text{Scope} = \text{Time} \times \text{Resources}$
- **Time is constrained:** 1-2 days

Can the scope of the plan be reduced?

- **SRS/SBRT: YES**
  - Palliative IMRT or 3D plans
  - Hypofractionation
  - Ablative dose for each fraction
  - Target is usually small
  - Palliation in nature
- **Chemo RT: NO**
  - Curative IMRT plans using multiple beams
  - The plan is generally complicated with large PTV
  - We will bite the bullet to get the plan done.
- **Emergency palliation:** Not really since the plan is already very simple.
Solution: a lean process

The Toyota Production System (TPS) points out two major flaws in mass production

- Producing components in large batches result in large inventories, and a high number of defects.
- Mass production is unable to accommodate consumer preferences for product diversity.

Build a lean process for time-constrained SRS/SBRT cases requires

- Level the production
- Planners with the right mentality
- Minimize the scope of the plan
- Every plan must be as simple as possible, but not simpler.
- Linear, not convoluted
TPS level the production fluctuation by

• Producing and receiving components and parts in small lot sizes.
• Optimizing and shortening the changeover procedures to produce a growing variety in smaller lot sizes.

RT is a production line but mass production doesn’t work in most places

• Mass production model
  – Every site is responsible by a group of planners
  – Hypothesis: Every planner in a group is an expert for the site and should maximize the productivity
  – Problem: waste when demand fluctuates
• Lean model:
  – Every planner should be able to plan every site
  – There is a go-to planners for each site
  – Problem: difficult plans not always done by the best planners

For time-constrained SRS/SBRT cases, the planner must

• Have the right mentality:
  – Keep cool under stress
  – Not a perfectionist
  – Understand that computer does most of the planning job. The planner mainly plays the supervising role
  – Trust other colleagues in the process
• Equipped wit mixed skills:
  – Be able to plan multiple sites: doesn’t have to be the “go-to” person for a specific site
  – Fluent with the multiple planning systems
  – Know the limitations of treatment planning system
  – Can identify/fix problems at the first sign
Is a perfect plan necessary?

"A good PLAN VIOLENTLY EXECUTED NOW IS BETTER THAN A PERFECT PLAN EXECUTED NEXT WEEK."

George S. Patton

Forget about the perfect plan, get a reasonably good plan first

• A perfect plan usually
  – Takes forever to achieve or might not even exist
  – Can be undeliverable (e.g., too many modulations)
  – Requires longer delivery time
  – Doesn’t make a significant difference clinically
• Instead, try to get a reasonably good plan
  – Quickly
  – Simple
  – Meets most, if not all constraints

Reduce the scope for SRS/SBRT

• Conformality index?
• Technique: 3D or IMRT?
• No. of beams/arcs?
• Single isocenter vs. multiple isocenters
• FFF beams or not?
Don’t kill yourself driving down the conformity index (CI)

- CI > 2 is bad
- In most cases, it is relatively easy to make CI < 1.6 but
- You might need a few more hours to drive CI < 1.2
- Suggestions: when time is constrained
  - Do not spend too much additional time once CI < 1.6
  - If CI is really important, use IMRT

Which technique one is better?

- 3D
  - Static
  - Conformal arc
  - Circular arc
  - Dynamic arc
- IMRT
  - Step-and-shoot
  - Sliding window
  - VMAT/rapid arc

For 3D, the plan quality is generally similar

- Arc beams take the least amount of time for planning and delivery
- Static beams have an advantage while trying to avoid OARs.
- Conformity index is not an issue except for targets with a very irregular shape
IMRT plans can achieve better dose conformity and uniformity but

- Take longer to plan, check and delivery
- Will require IMRT QA
- Not easy to produce traditional SRS non-uniform (max 125%) dose distribution
- Low dose bath can be a problem

Technique Selection for SRS/SBRT

- **IMRT**
  - If the target is irregularly shaped or
  - Dose uniformity and CI is a concern (e.g., dmax <110%)
  - Try VMAT/RapidArc first for faster delivery
  - Use STSH or SLWD for potentially better OAR sparing
- **3D**
  - If the target is regularly shaped (e.g., spherical) and
  - Higher dmax allowed.
  - Use static beams if PTV is close to OARs
  - Otherwise, use arc beams

Reports recommend 5 arcs or 15 static beams for brain SRS/SBRT, but

- For brain SRS, it might be sufficient using
  - 3 couch angles with
  - 3 dynamic/conformal arcs or
  - 10 static/IMRT beams.
- For brain SBRT,
  - 2 (e.g., 0 and 90) couch angles with
  - 2 VMAT/RapidArc beams or
  - 7-8 IMRT beams.
Single isocenter for multiple targets saves planning and delivery time

- Not limited to VMAT/RapidArc
- Can also be used for STSH, SLWD, DARC...
- Potential additional setup error due to rotation
- Use slightly larger PTV margin if necessary

FFF beams will speed up the delivery for SRS/SBRT

- The target is generally small: you can get a good plan with either FFF or traditional beams
- The delivery is faster for a SRS/SBRT plan using FFF beams.
- FFF is great for SRS that requires non-uniform dose distribution within PTV

Yes, we all joke about P&P but the reality is that... we need them particularly for time constrained cases

- Run the TP operation fairly, effectively and efficiently
- Deal with many users, each with different personality and individual need.
- Be prepared when there is an emergency.
- Say NO to people with unreasonable requests.
Conclusions

• Time-constraint cases are manageable.

• Implement a lean process:
  – Avoid convoluted process
  – Level the production by training the planners with the right mentality and mix of skills
  – Reduced planning scope

• Have a written P&P
  – Algorithm for choosing planning approach
  – Clear acceptance and rejection criteria