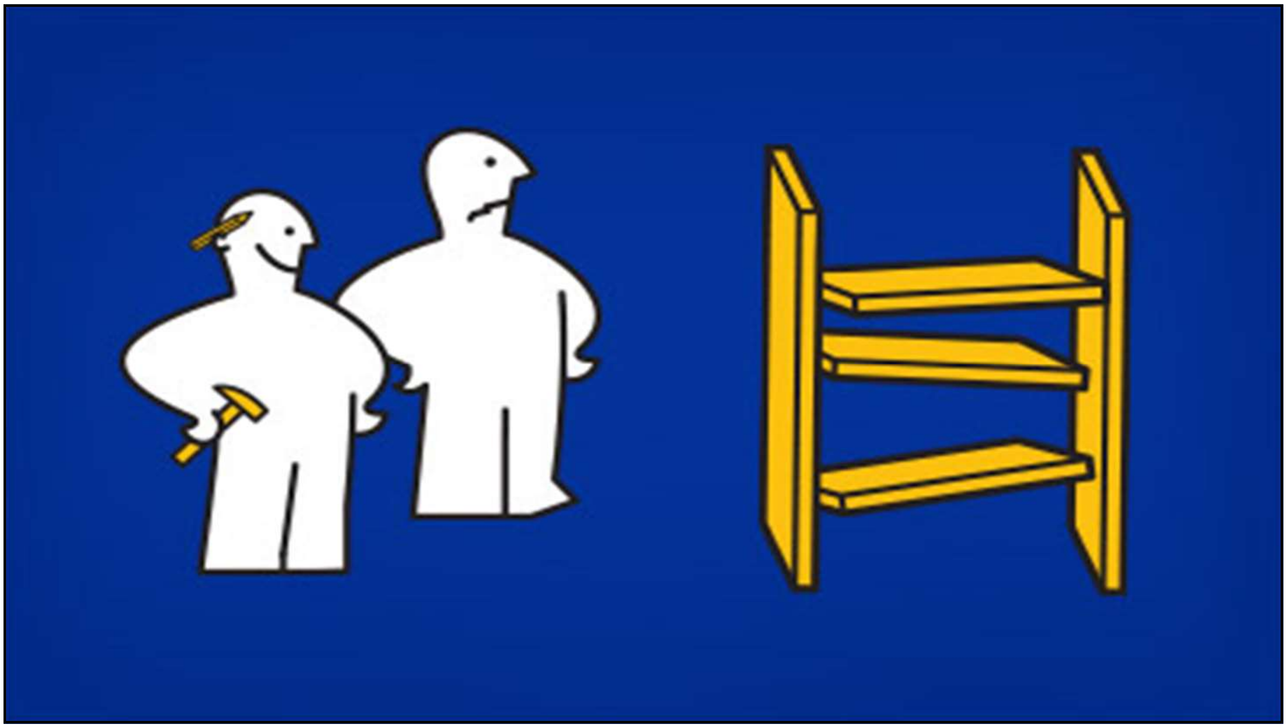
AAMD REGIONAL MEETING

Challenging Paradigms & Translating Research To Treatment Planning Tricks

Mubin “Ben” Shaikh MS, DABR

RADIATION KNOWLEDGE

ROCHESTER REGIONAL HEALTH



ARTICLE | JOURNAL OF CONSUMER PSYCHOLOGY | JULY 2012

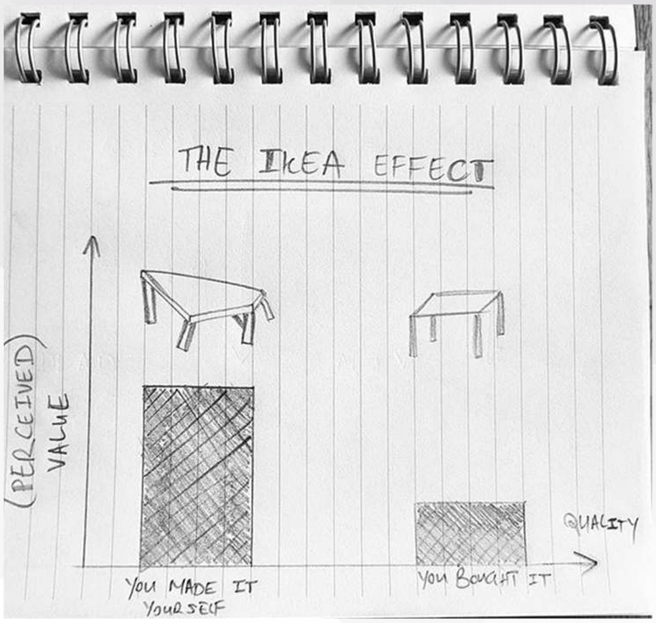
The IKEA Effect: When Labor Leads to Love

by **Michael I. Norton**, Daniel Mochon and Dan Ariely

PRINT SHARE EMAIL

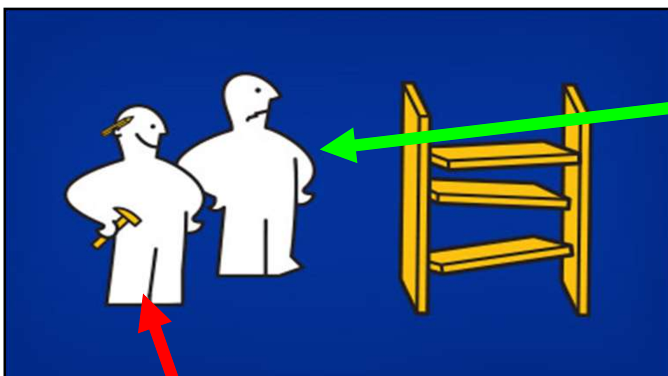
Abstract

In four studies in which consumers assembled IKEA boxes, folded origami, and built sets of Legos, we demonstrate and investigate boundary conditions for the IKEA effect—the increase in valuation of self-made products. Participants saw their amateurish creations as similar in value to experts' creations, and expected others to share their opinions. We show that labor leads to love only when labor results in successful completion of tasks; when participants built and then destroyed their creations, or failed to complete them, the IKEA effect dissipated. Finally, we show that labor increases valuation for both "do-it-yourselfers" and novices.



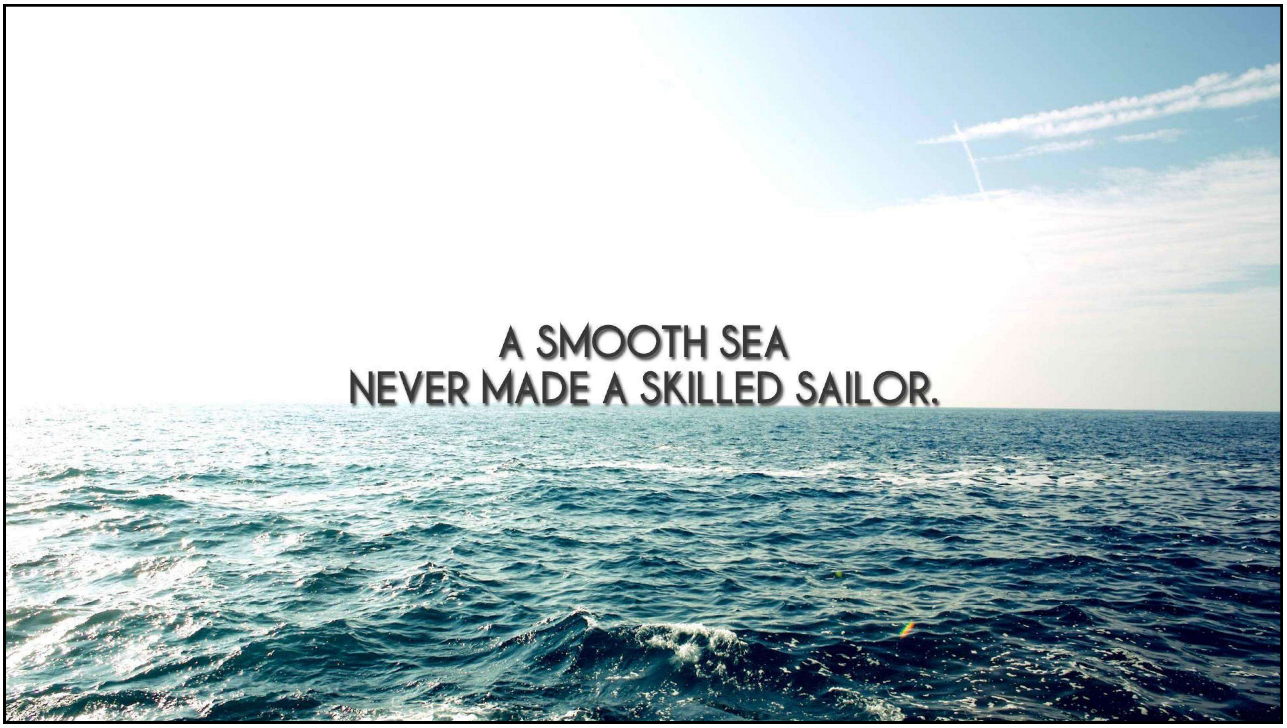
"Ikea Effect" - We **LOVE** it more when we make it.

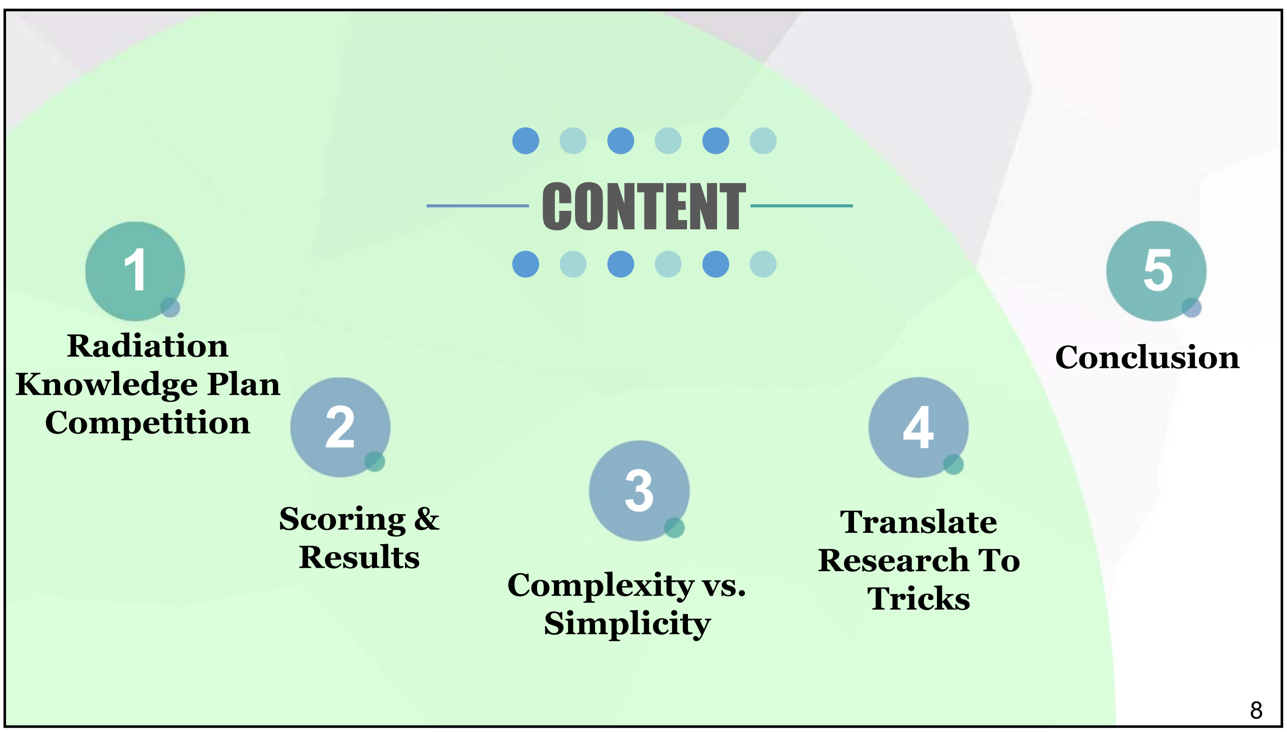
LOVE = Cognitive Bias.



Physician
Physicist
Therapist

Dosimetrist


A SMOOTH SEA
NEVER MADE A SKILLED SAILOR.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Scoring & Results
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Complexity vs. Simplicity
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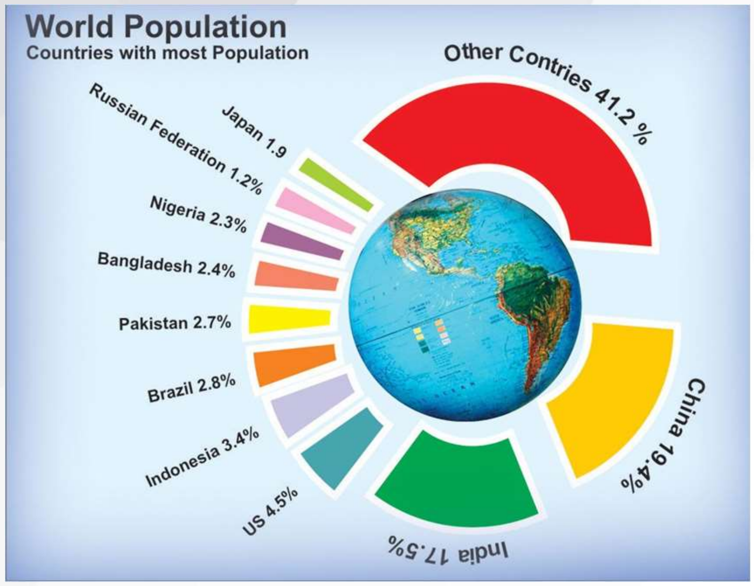
The International Challenge.

PART 1



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2017 Participants - Diverse Group Of Participants

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Asia	755
Africa	113
Europe	471
North America	193
Latin America	101
Australia	38

94 Countries - Diversity of data points and inclusion of “out-of-the-box” thinking.

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2017 Plan Competition – H&N Nasopharynx

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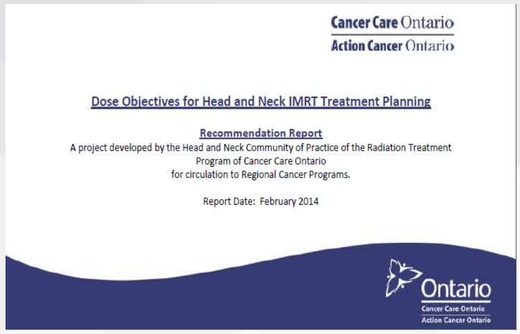
Dose Details: 70 Gy (PTV70), 63 Gy (PTV63), and 56 Gy (PTV56) in 35 fractions

Dosimetric Protocol:


Cancer Care Ontario
Action Cancer Ontario

Dose Objectives for Head and Neck IMRT Treatment Planning

Recommendation Report
A project developed by the Head and Neck Community of Practice of the Radiation Treatment Program of Cancer Care Ontario for circulation to Regional Cancer Programs.

Report Date: February 2014

Ontario
Cancer Care Ontario
Action Cancer Ontario

Total : 31 dosimetric objectives (9 PTV focused). Plans graded on a 100 point scale.

Plans' Categories
Clinical Plan: Plan with practical settings (trt. time, # fields, ... etc)
Fantasy Plan: Planner can use any possible planning parameters, *sky is the limit*

Allowed Techniques 3D-CRT, IMRT, VMAT, HT, IMPT

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Control variables.

RADIATION KNOWLEDGE

- **Control variables:**
  - **Patient model (CT Image)**
  - **Patient Anatomy (RT Structure Set - Should not be modified)**
  - **Provided Consistent Planning Goals**
  - **Modern Dose Algorithm Recommended & Resolution (< 3mm)**
- **General Planning Considerations**
  - **Dosimetric Objectives : 31 dosimetric objectives that provide a total score of 100 points.**
  - **Total of Nine PTV objectives (30 points out of 100)**
- **Checks & Balances as Referees**

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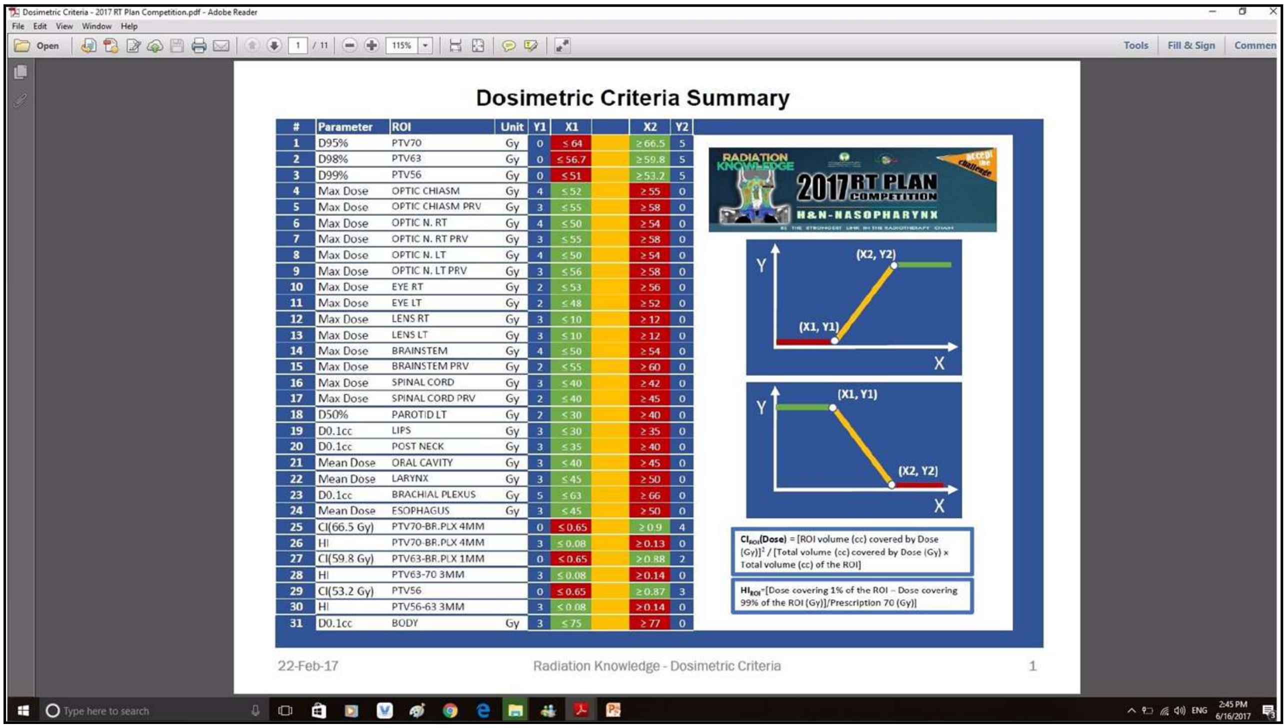


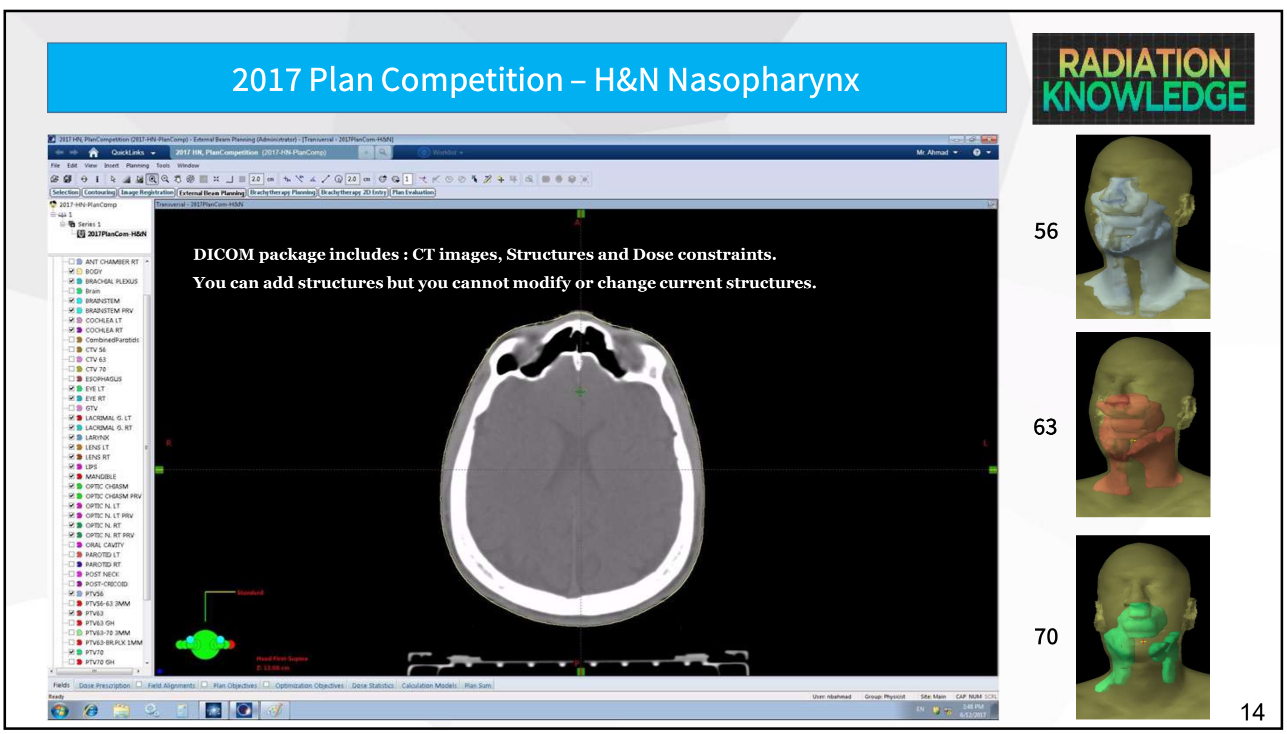
Dosimetric Criteria Summary

#	Parameter	ROI	Unit	Y1	X1		X2	Y2
1	D95%	PTV70	Gy	0	≤ 64		≥ 66.5	5
2	D98%	PTV63	Gy	0	≤ 56.7		≥ 59.8	5
3	D99%	PTV56	Gy	0	≤ 51		≥ 53.2	5
4	Max Dose	OPTIC CHIASM	Gy	4	≤ 52		≥ 55	0
5	Max Dose	OPTIC CHIASM PRV	Gy	3	≤ 55		≥ 58	0
6	Max Dose	OPTIC N. RT	Gy	4	≤ 50		≥ 54	0
7	Max Dose	OPTIC N. RT PRV	Gy	3	≤ 55		≥ 58	0
8	Max Dose	OPTIC N. LT	Gy	4	≤ 50		≥ 54	0
9	Max Dose	OPTIC N. LT PRV	Gy	3	≤ 56		≥ 58	0
10	Max Dose	EYE RT	Gy	2	≤ 53		≥ 56	0
11	Max Dose	EYE LT	Gy	2	≤ 48		≥ 52	0
12	Max Dose	LENS RT	Gy	3	≤ 10		≥ 12	0
13	Max Dose	LENS LT	Gy	3	≤ 10		≥ 12	0
14	Max Dose	BRAINSTEM	Gy	4	≤ 50		≥ 54	0
15	Max Dose	BRAINSTEM PRV	Gy	2	≤ 55		≥ 60	0
16	Max Dose	SPINAL CORD	Gy	3	≤ 40		≥ 42	0
17	Max Dose	SPINAL CORD PRV	Gy	2	≤ 40		≥ 45	0
18	D50%	PAROTID LT	Gy	2	≤ 30		≥ 40	0
19	D0.1cc	LIPS	Gy	3	≤ 30		≥ 35	0
20	D0.1cc	POST NECK	Gy	3	≤ 35		≥ 40	0
21	Mean Dose	ORAL CAVITY	Gy	3	≤ 40		≥ 45	0
22	Mean Dose	LARYNX	Gy	3	≤ 45		≥ 50	0
23	D0.1cc	BRACHIAL PLEXUS	Gy	5	≤ 63		≥ 66	0
24	Mean Dose	ESOPHAGUS	Gy	3	≤ 45		≥ 50	0
25	CI(66.5 Gy)	PTV70-BR.PLX 4MM		0	≤ 0.65		≥ 0.9	4
26	HI	PTV70-BR.PLX 4MM		3	≤ 0.08		≥ 0.13	0
27	CI(59.8 Gy)	PTV63-BR.PLX 1MM		0	≤ 0.65		≥ 0.88	2
28	HI	PTV63-70 3MM		3	≤ 0.08		≥ 0.14	0
29	CI(53.2 Gy)	PTV56		0	≤ 0.65		≥ 0.87	3
30	HI	PTV56-63 3MM		3	≤ 0.08		≥ 0.14	0
31	D0.1cc	BODY	Gy	3	≤ 75		≥ 77	0

CI_{ROI}(Dose) = [ROI volume (cc) covered by Dose (Gy)]^2 / [Total volume (cc) covered by Dose (Gy) × Total volume (cc) of the ROI]

HI_{ROI}=[Dose covering 1% of the ROI – Dose covering 99% of the ROI (Gy)]/Prescription 70 (Gy)]

22-Feb-17 Radiation Knowledge - Dosimetric Criteria 1



2017 Plan Competition – Clinical vs. Fantasy Plans

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Plan Submission

Categories:

- **Clinical Plan**
- **Fantasy Plan**

Clinical Plan:

- **Clinical settings**
- **Reasonable Beam-On Time**

Fantasy Plan:

- **Use all available resources**
- **Be creative**

GENERAL PLAN REQUIREMENTS

Criteria		Clinical Plans	Fantasy Plans
RT Category		External Beam Radiation Therapy ONLY	External Beam Radiation Therapy ONLY
RT Technique		3D-CRT/IMRT/VMAT/TOMO/CK/IMPT	3D-CRT/IMRT/VMAT/TOMO/CK/IMPT/…
# of Isocenters		**ONE**, unless machine limitations exist	**ONE**, unless machine limitations exist
Dose Grid		Uniform size **&** size **< 3mm** (The Smaller the better)	Uniform size **AND** size **< 3mm**
Heterogeneity		Heterogeneity Corr. Should be used	Heterogeneity Corr. Should be used
Energy		Single or mixed beams	Single or mixed beams
Bolus		No Bolus allowed	No Bolus allowed
Hybrid Technique		Allowed	Allowed
# of Fields	3D-CRT	Max of **9 fields**, Max of **5 non-coplanar**	No Limit
	IMRT	Max of **9 fields**, **All** should be **coplanar**	No Limit
	VMAT	Max of **4 arcs**, **All** should be **coplanar**	No Limit
	IMPT	Max of **5 fields**, **All** should be **coplanar**	No Limit
BeamOn Time	3D-CRT	Should be less than **10 min**	Should be less than **10 min**
	IMRT	Should be less than **25 min**	Should be less than **30 min**
	VMAT	Should be less than **10 min**	Should be less than **15 min**
	IMPT	Should be less than **10 min**	Should be less than **15 min**
	TOMO	Should be less than **20 min**	Should be less than **30 min**

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Plan Competition Concept

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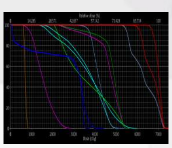
Package



Download

Planning

Four Weeks

Best Plans

Share Best Plans
Webinars & Documents

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PART 2

The Scoring

We are striving for a fair comparison

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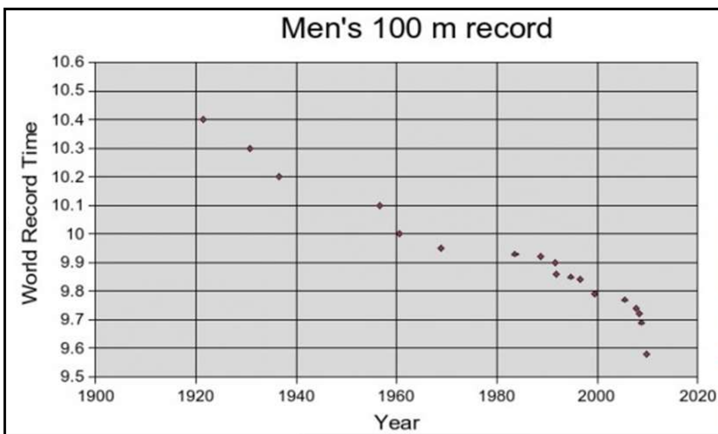
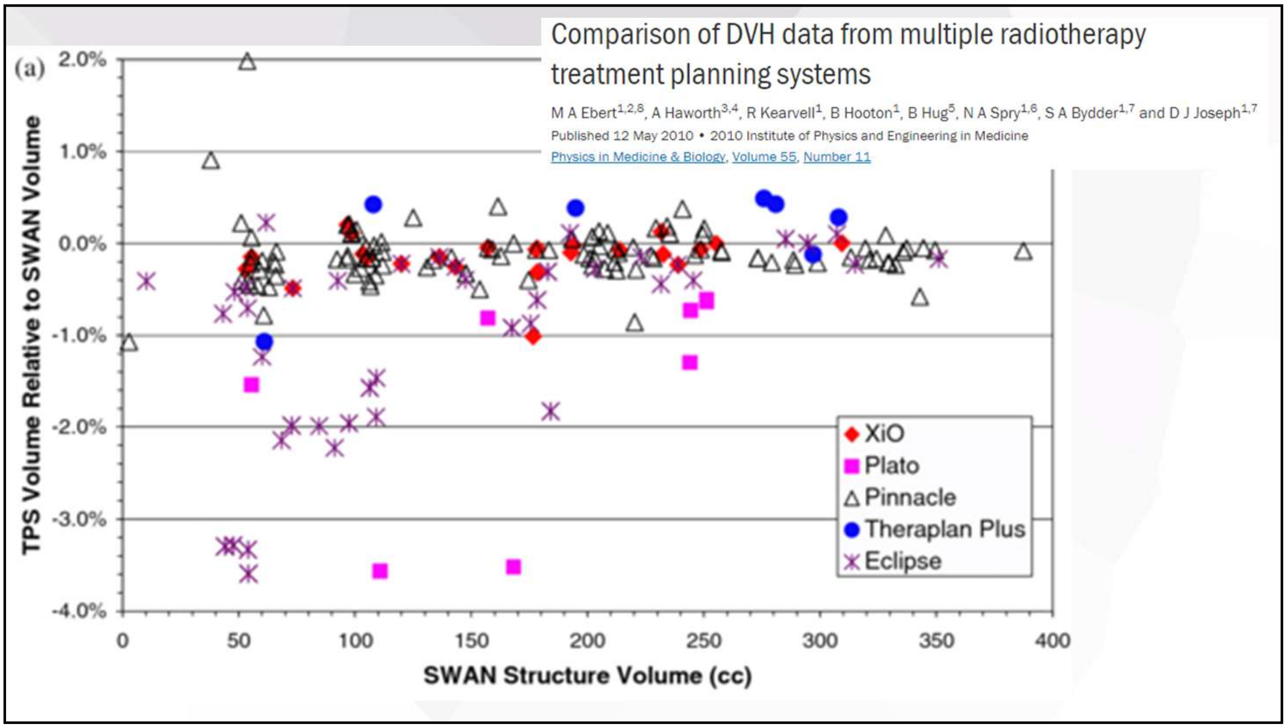


Last Two Decades : The difference between the winners was a mere ⅓ of a second.



Latent Planning System Differences

The TPS converts 2D contours into 3D voxels and reports back a DVH. To do so it needs to make some decisions:

1. What happens between slices
2. What happens at the edge of the contour.

DVH is not absolute.

To remove the bias and algorithmic difference between treatment planning systems we re-calculated the DVH based on the submitted DICOM data and then evaluated based on a scoring scale.

Pyplanscoring (written by Dr. Victor Gabriel Leandro Alves, D.Sc.) is :

- Vendor neutral
- It offers batched analysis
- It's validated with 800+ plans.

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PyPlanScoring – Validation Results

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Calculated versus analytical values

Test 1 – varying dose grid resolution: 0.2 mm to 3 mm

	Delta > +/- 3%	Delta %
Total Volume (cc)	0	-0.7 - 0.5
Dmin	0	-0.1 - 2.6
Dmáx	0	-0.4 - 0.0
Dmean	0	-0.2 - 0.3
D99	0	-1.9 - 1.9
D95	0	-1.3 - 0.4
D5	0	-0.3 - 0.2
D1	0	-0.1 - 0.2
D0.03cc	8	-0.1 - 5.8

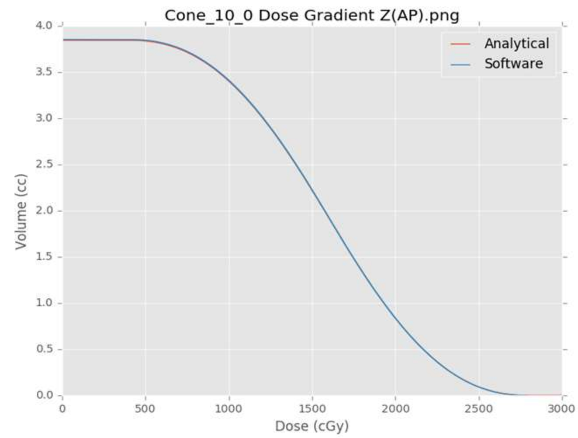
Test 2 – Matched contour and dose grid resolution

	Delta > +/- 3%	Delta %
Total Volume (cc)	2	-3.9 - 0.6
Dmin	0	-0.2 - 2.6
Dmáx	0	-0.4 - 0.0
Dmean	0	-0.8 - 0.7
D99	8	-14.4 - 5.2
D95	2	-4.2 - 3.2
D5	0	-0.7 - 0.9
D1	0	-1.1 - 2.7
D0.03cc	11	0.2 - 10.0

Med Phys. 2015 Aug;42(8):4435-48. doi: 10.1118/1.4923175.

Methods, software and datasets to verify DVH calculations against analytical values: Twenty years late(r).

Nelms B[1], Stambaugh C[2], Hunt D[3], Tonner B[3], Zhang G[3], Feygelman V[3].



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PART 2

The Results.

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TPS Statistics – 1672 Planners – 94 Countries

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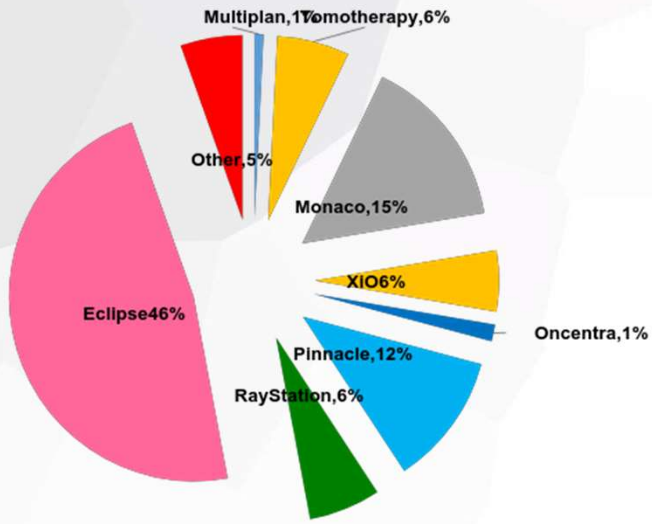
Varian - Eclipse:
786 planners from 69 countries

Elekta – Monaco, XiO, & Oncentra:
Monaco 254 , XiO 88 & Oncentra 24 planners

Philips - Pinnacle:
192 planners from 24 countries

RaySearch - RayStation:
104 planners from 18 countries

Accuray – Tomotherapy & Multiplan:
Tomo 105 & Multiplan 13 planners



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Variability

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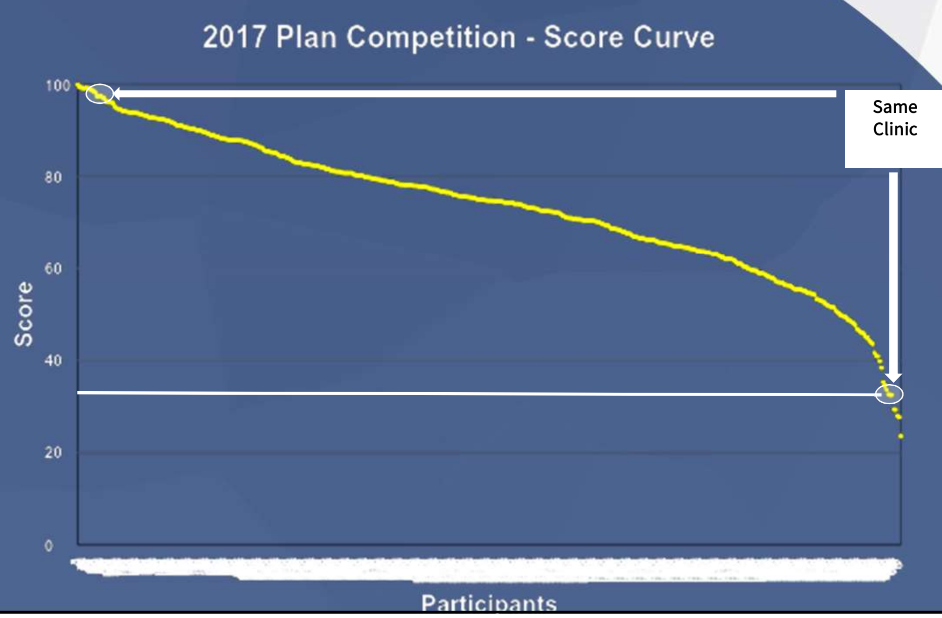

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Clinical Plans – Top Planners Per TPS

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Planner Name	Country	Technique	Final Score	TPS	Hospitals
Chung Yin Mak	China-HK	VMAT	99.5	Varian-Eclipse	St. Teresa's Hospital
Friedemann Herberth	Switzerland	VMAT	99.3	Varian-Eclipse	Kantonsspital St.Gallen
Jonathan Stenbeck	United States	VMAT	99.0	Varian-Eclipse	Greenville Health System
Kai Leung Li	China-HK	VMAT	98.7	Varian-Eclipse	St. Teresa's Hospital
Simon Heinze	Switzerland	TOMO	98.2	Accuray-Tomotherapy	Kantonsspital St.Gallen
Lian Soo Lum	Malaysia	TOMO	96.0	Accuray-Tomotherapy	Mount Miriam Cancer Hospital
Fazal Khan	United States	IMPT	99.1	RaySearch-RayStation	Mayo Clinic (Phoenix, AZ
Rolland Julien	France	VMAT	98.5	Raysearch-RayStation	Institut Paoli-Calmettes – Centre Hospitalier des
Shengpeng Jiang	China	VMAT	96.2	Philips-Pinnacle	Tianjin Medical University Cancer Institute & Hospital
Wa Wai Mok	China-HK	VMAT	94.7	Philips-Pinnacle	Tuen Mun Hospital
Irina Fotina	Germany	IMRT	94.2	Elekta-Monaco	Self Employed
Charbel Attieh	Bahrain	IMRT	93.3	Elekta-Monaco	King Hamad University Hospital

Eclipse ®, Tomotherapy ® and RayStation ® are within +/- 1.0.

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Focus on the sailor not the sailboat

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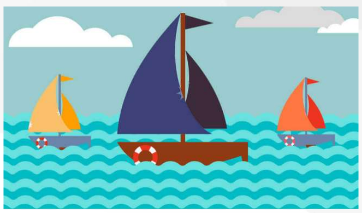
All Modalities and Planning Systems show variability.

Most TPS are capable of high scores

No statistical difference between the min ,mean and max plan scores between Eclipse® Raystation ® and Tomotherapy®. All systems show variability.

It's not about the sailboat, it's about the sailor.



Re : Naysayers / Critique

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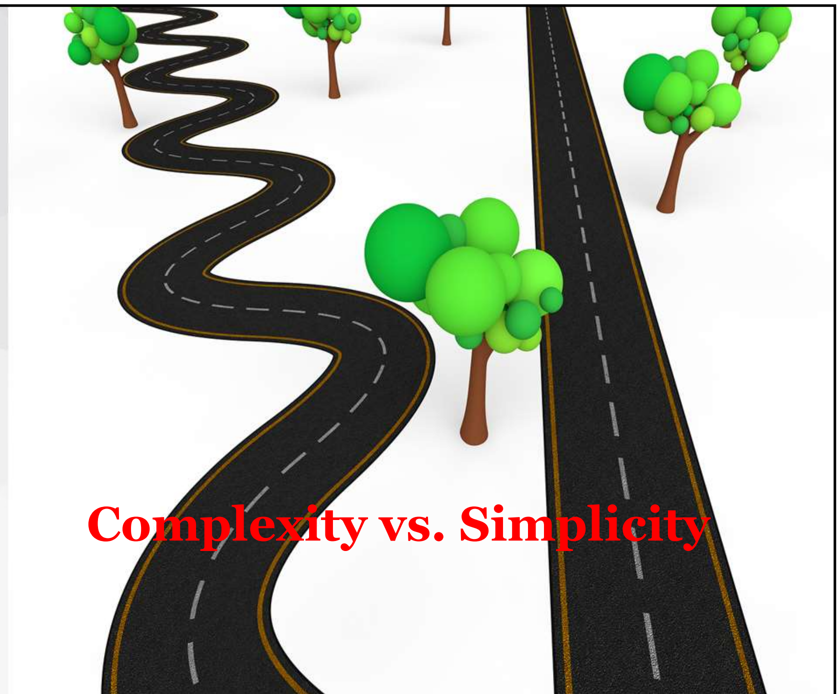
Naysayers/Critique:
1. The competition is biased by vendors.
2. The competition is biased to high performer
3. Not accounting for treatment planning system differences.
4. Plan is not deliverable

Our Response:
1. We do not receive any support from vendors.
2. That's true.
3. We have removed the bias of how TPS report dose by re-calculating the dose independently.
4. In the future, we are going to ask planners to submit QA delivery reports.

PART 3

Complexity vs. Simplicity



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"To get a high score, you have to build an extremely complex treatment plan consisting of small MLC fields and excessive Monitor Units " Dosimetrist

- Agree
- Disagree

Correlation between complexity and deliverability.

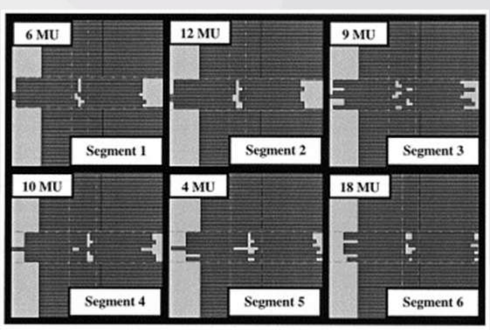
Predicting deliverability of volumetric-modulated arc therapy (VMAT) plans using aperture complexity analysis

Kelly C. Younge[a], **Don Roberts**, **Lindsay A. Janes**, **Carlos Anderson**, **Jean M. Moran**, and **Martha M. Matuszak**
Department of Radiation Oncology, University of Michigan, Ann Arbor, MI

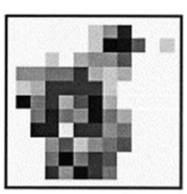
$$M = \frac{1}{MU} \sum_{i=1}^{N} MU_i \times \frac{y_i}{A_i}$$

A complexity threshold of **< 0.180 mm−1** was a good metric for deciding which plans would pass IMRT QA. (649 VMAT plans)

Complexity Explained



(a)



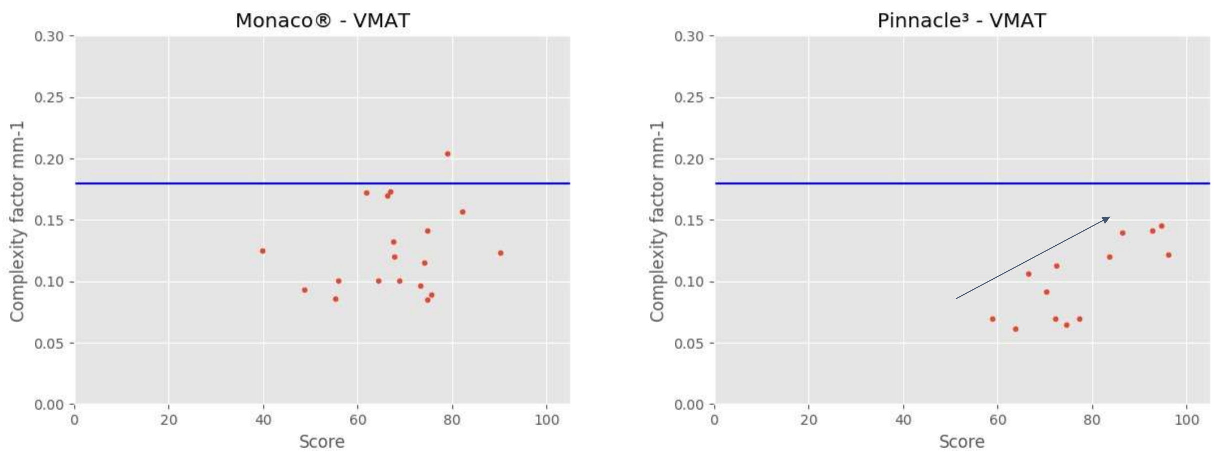
(b)

The TPS breaks down your fluence map into a series of deliverable segments.

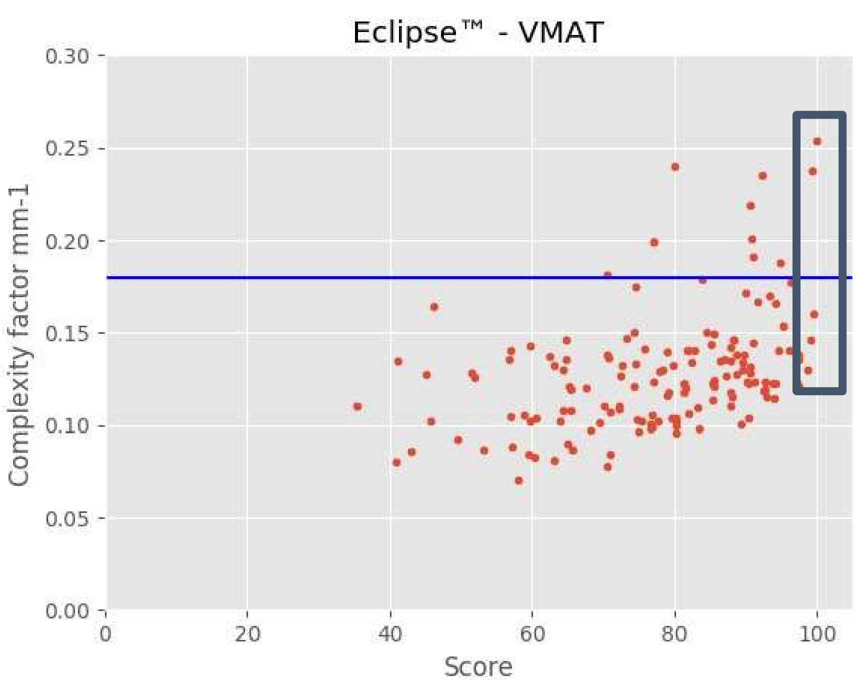
Complex segment shapes have a few problems:
- Greater dependence on MLC leaf position
- More sensitive to MLC modeling
- Reduced confidence in dose calculation.

The aforementioned metric takes into account aperture size and the number MU used to deliver the segment.

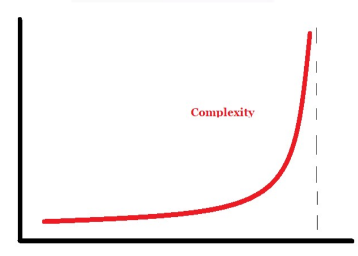
Monte Carlo simulation for MLC-based intensity-modulated radiotherapy
Todd Pawlicki [a], C.-M.Charlie Ma [a]

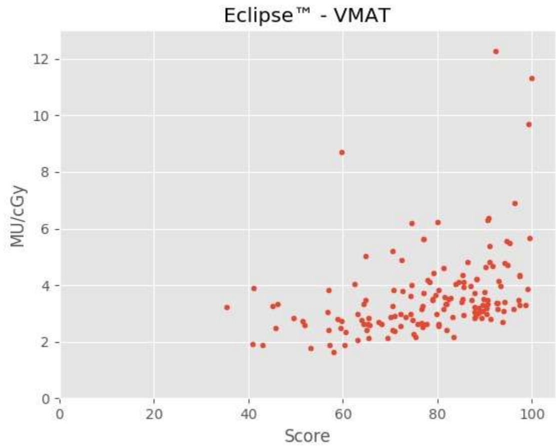


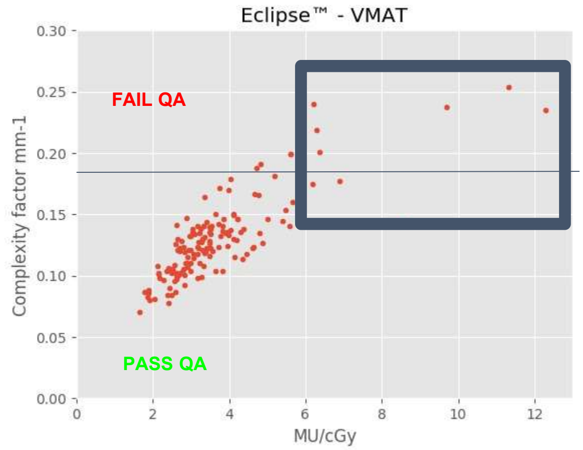
- For Pinnacle, there is a general trend between complexity and score.
- For Monaco that tradeoff vanishes.



Trade-off between complexity and a high score







Higher modulation (MU/cGy) is not required for a high score

Increasing MU modulation ---> more complex plans that are less likely to be deliverable.

PART 4

Translating Research To Treatment Planning Tricks

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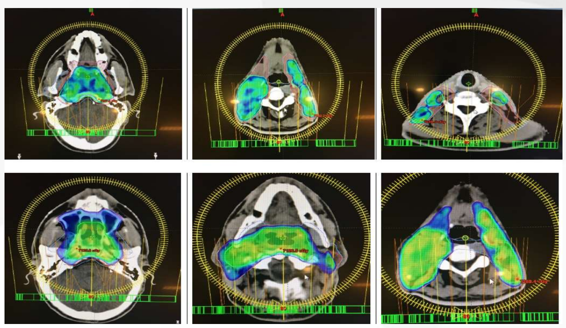
Possible combinations of treatment plans: 1,000,000,000,000,000,000 (Too many)

Clinical
99.5/100

Name: **Chung Yin Mak ("Philip")**
Country: **Hong Kong - China**
Hospital: **St. Teresa's Hospital**
Technique: **VMAT with Eclipse v11**
Rank: **1st place**
Machine: **Varian Truebeam (1400 MU/min) - High Def MLC**

Plan Details:

Energy: 6FFF , 4 Full Arcs , Linac: TrueBeam



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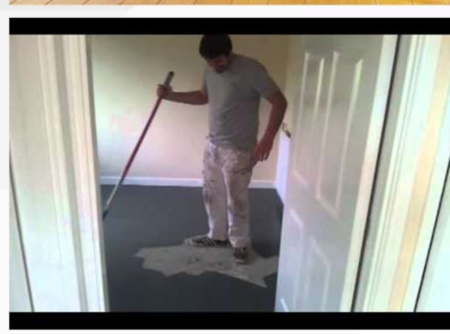
Planning Is Like Painting

1. Choose Your Paint - Beam Energy.
2. Choose Your Brush - Beam Angles.
3. Blue Tape - Optimization Structures

Edges = Low Dose Region.
Skip Fancy Table Kicks
Limit MU to 3-4X the daily dose

Review Two Best Plans :
1. Eclipse
2. Monaco

Best plan broken down in three steps:
1. Contours & Optimization Structures
2. Beam Angles & Energy
3. Optimization

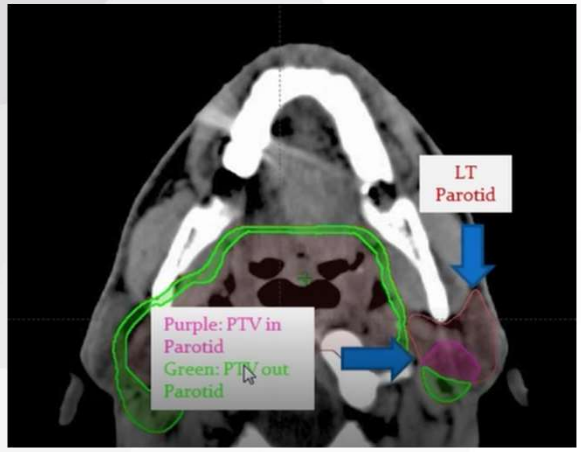


1. Contours

Break Down Overlap:
- PTV70: Lt Parotid
- PTV70 : Brainstem
- PTV56: Eyeball

Smooth all structures using level 3

Set all structures to high resolution and calculation grid to 1.5 mm



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Virtual target ring

RADIATION KNOWLEDGE

Virtual tissue ring

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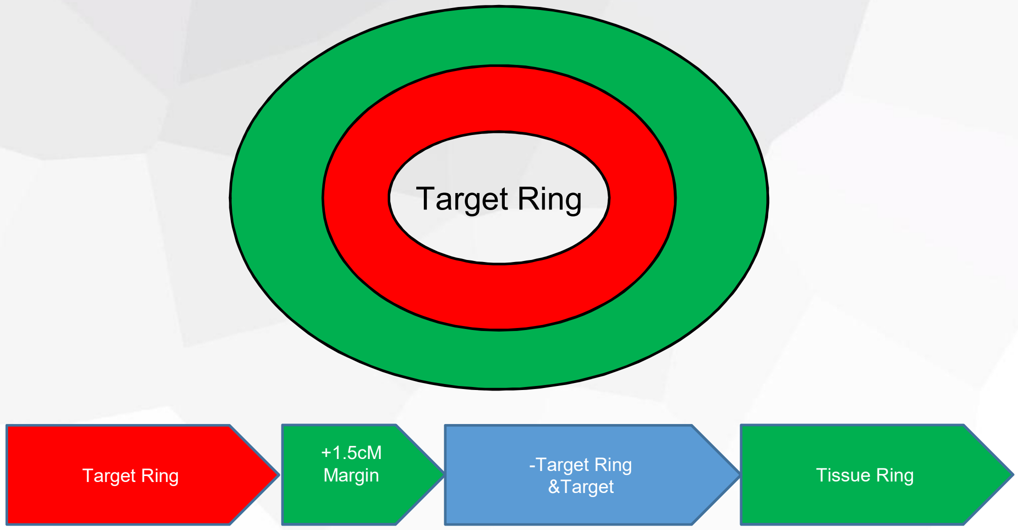
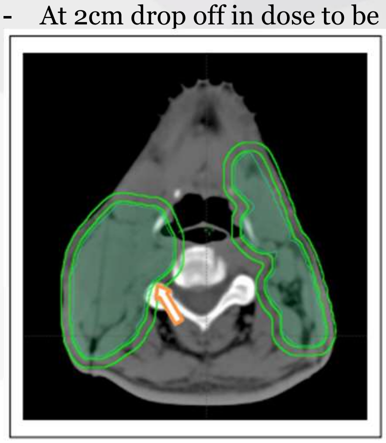
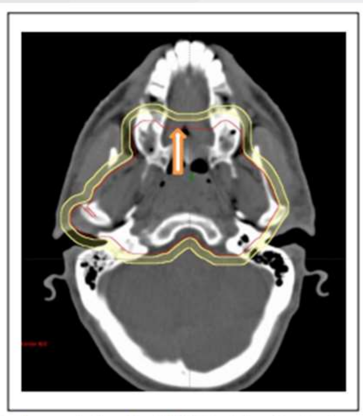


Contours : Rings (Visual) or NTO (Easier)

- Create a conformal ring of 5mm for the PTV's, with 1mm gap from target.
- **Dose Penumbra : 2.5 Gy per mm.**
- Adjust the gap to allow more freedom in dose drop off.
- At 2cm drop off in dose to be 50%



Conformal-ring for PTV70 with 1mm gap



Conformal-ring for PTV56 with adjusted gap

Tip1 :

Tip: More emphasis you place on the target and OAR, the weaker the impact of the rings on the cost function.

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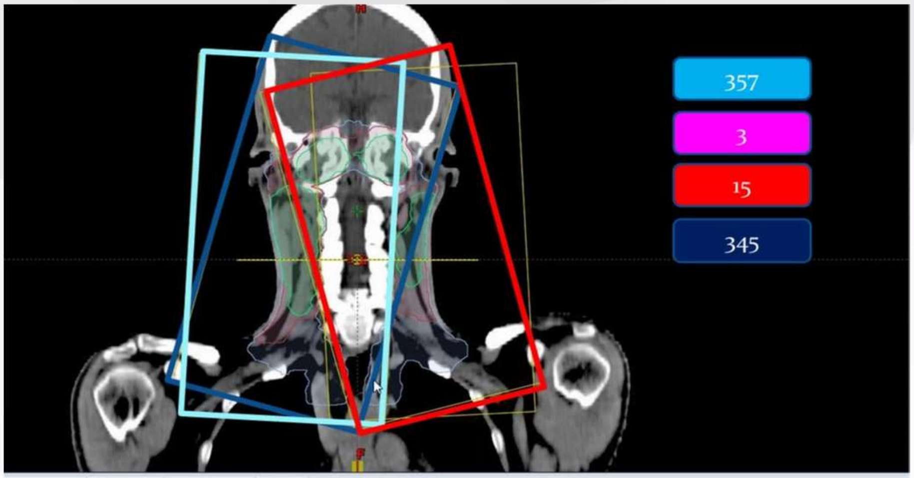
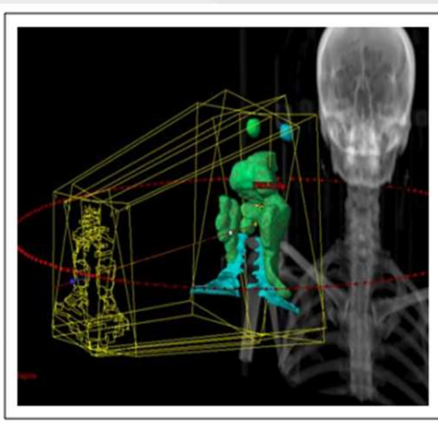
2. Beam Angles



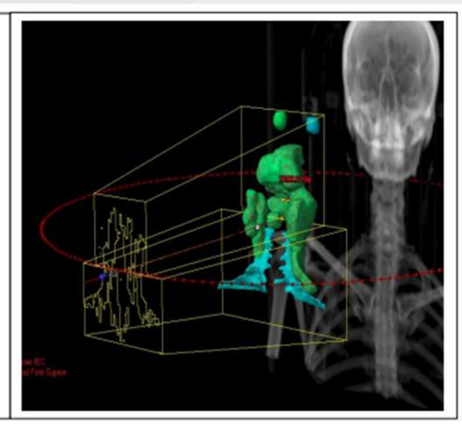
Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]
1.515	Varian IEC	179.9 CCW 180.1	357.0	0.0	None	16.9	+13.9	+3.0	30.1	+13.8	+16.3	0.00	4.00	0.00
1.393	Varian IEC	180.1 CW 179.9	3.0	0.0	None	16.9	+3.0	+13.9	31.1	+14.0	+17.1	0.00	4.00	0.00
1.394	Varian IEC	179.9 CCW 180.1	15.0	0.0	None	16.0	+4.0	+12.0	31.0	+14.2	+16.8	0.00	4.00	0.00
1.350	Varian IEC	179.9 CCW 180.1	345.0	0.0	None	16.0	+12.0	+4.0	30.1	+14.1	+16.0	0.00	4.00	0.00

2. Beam Angles & Energy

- Place the PTV at the center of the arcs. Collimator rotations between 0 -90
- Close second - 6 arc plan.
- Energies : 6 and 10X
- No fancy couch kicks needed.



4-Arcs (2+2)



6-Arcs (2+2+2)

3. Optimization

RADIATION KNOWLEDGE

1. Stage One - Aiming for PTV Coverage.
2. Stage Two - Emphasis on conformity and homogeneity of PTV
3. Stage Three - Emphasis on OAR.

Pause optimizer, make tweaks , and resume.

For dose Level 70(D95%>6650):

	Volume	Upper Objective	Lower Objective	Priority
V_66.7	1%	7000		50
	2%	6990		50
	0.1%	7300		80
	99.5%		6660	100
	98.5%		6670	100
	97.5%		6680	100
V_Paro_in66.7	96.5%		6690	80
	97		6680	80

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Homogeneity index (HI)

RADIATION KNOWLEDGE

HI_{ROI}=[Dose covering 1% of the ROI – Dose covering 99% of the ROI (Gy)]/Prescription 70 (Gy)]

Achieve H.I:

I. PTV70: PTV70-BR.PLX 4mm
II. PTV63: PTV63-70 3mm
III. PTV56: PTV 56-63 3mm

For HI target, upper and lower objectives:

I. Upper=103-105% of target dose
II. Lower=101% of target dose

Conformity Index (C.I)

RADIATION KNOWLEDGE

CI_{ROI}**(Dose)** = [ROI volume (cc) covered by Dose (Gy)]^2 / [Total volume (cc) covered by Dose (Gy) x Total volume (cc) of the ROI]

Achieve C.I Using: virtual target **rings**

Set ONLY lower objectives

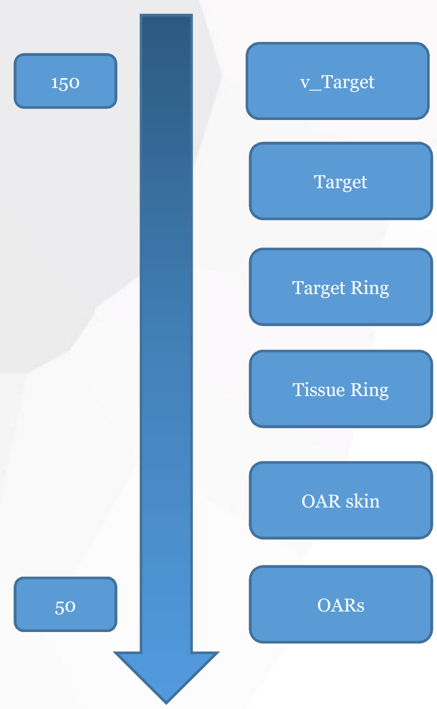
Remarks for optimization

Preliminary Priority Range:

I. 50-150
II. Targets: lower=100, upper=80
III. OARs: 50-80

Priority of **OARs** will modify according the difficulty

For any additional structures in 2nd optimization or later one, priority range is **80-100.**



RADIATION KNOWLEDGE

Given Targets

RADIATION KNOWLEDGE

Dose Level	Name	Criteria
70	PTV70	D95
	PTV70-BR.PLX 4mm	CI & HI
63	PTV63	D98
	PTV 63-BR.PLX 1mm	CI
	PTV 63-70 3mm	HI
56	PTV 56	D99 & CI
	PTV56-63 3mm	HI

Back bone of the target coverage
For 70, aims 66.5Gy
For 63, aims 59.8Gy
For 56, aims 53.2Gy

For PTV63 & PTV56,
No upper objective should be set

Chung Yin Mak - Eclipse - VMAT - Clinical (Trial) - March 30, 2017 (1:10 PM KSA Time)

	constrain	constrain_value	constrains_type	value_low	value_high	Max Score	Result	Raw Score	Performance
PTV70	D95	95	lower	6400.00	6650.00	5.00	6655.96	5.00	100.0%
PTV63	D98	98	lower	5670.00	5980.00	5.00	6013.81	5.00	100.0%
PTV56	CI	5320	lower	0.65	0.87	3.00	0.84	2.61	86.9%
PTV56	D99	99	lower	5100.00	5320.00	5.00	5327.15	5.00	100.0%
OPTIC CHIASM	max	max	upper	5200.00	5500.00	4.00	4533.00	4.00	100.0%
OPTIC CHIASM PRV	max	max	upper	5500.00	5800.00	3.00	5391.00	3.00	100.0%
OPTIC N. RT	max	max	upper	5000.00	5400.00	4.00	4927.00	4.00	100.0%
OPTIC N. RT PRV	max	max	upper	5500.00	5800.00	3.00	5446.00	3.00	100.0%
OPTIC N. LT	max	max	upper	5000.00	5400.00	4.00	4865.00	4.00	100.0%
OPTIC N. LT PRV	max	max	upper	5600.00	5800.00	3.00	5461.00	3.00	100.0%
EYE RT	max	max	upper	5300.00	5600.00	2.00	5248.00	2.00	100.0%
EYE LT	max	max	upper	4800.00	5200.00	2.00	4709.00	2.00	100.0%
LENS RT	max	max	upper	1000.00	1200.00	3.00	966.00	3.00	100.0%
LENS LT	max	max	upper	1000.00	1200.00	3.00	965.00	3.00	100.0%
BRAINSTEM	max	max	upper	5000.00	5400.00	4.00	4545.00	4.00	100.0%
BRAINSTEM PRV	max	max	upper	5500.00	6000.00	2.00	5460.00	2.00	100.0%
SPINAL CORD	max	max	upper	4000.00	4200.00	3.00	3601.00	3.00	100.0%
SPINAL CORD PRV	max	max	upper	4000.00	4500.00	2.00	3945.00	2.00	100.0%
PAROTID LT	D50	50	upper	3000.00	4000.00	2.00	2941.20	2.00	100.0%
LIPS	Dcc	0.1	upper	3000.00	3500.00	3.00	2952.05	3.00	100.0%
POST NECK	Dcc	0.1	upper	3500.00	4000.00	3.00	3194.93	3.00	100.0%
ORAL CAVITY	mean_value	mean	upper	4000.00	4500.00	3.00	3821.75	3.00	100.0%
LARYNX	mean_value	mean	upper	4500.00	5000.00	3.00	4152.10	3.00	100.0%
BRACHIAL PLEXUS	Dcc	0.1	upper	6300.00	6600.00	5.00	6228.12	5.00	100.0%
ESOPHAGUS	mean_value	mean	upper	4500.00	5000.00	3.00	2451.72	3.00	100.0%
PTV70-BR.PLX 4MM	CI	6650	lower	0.65	0.90	4.00	0.91	4.00	100.0%
PTV70-BR.PLX 4MM	HI	7000	upper	0.08	0.13	2.00	0.08	2.00	100.0%
PTV63-BR.PLX 1MM	CI	5980	lower	0.65	0.88	3.00	0.88	2.98	99.5%
PTV63-70 3MM	HI	6300	upper	0.08	0.14	3.00	0.08	2.97	99.1%
PTV56-63 3MM	HI	5600	upper	0.08	0.14	3.00	0.08	2.98	99.5%
BODY	Dcc	0.1	upper	7500.00	7700.00	3.00	7085.49	3.00	100.0%
					Max Score:	100.00	Total Score:	99.55	99.5%

Clinical
94.2/100

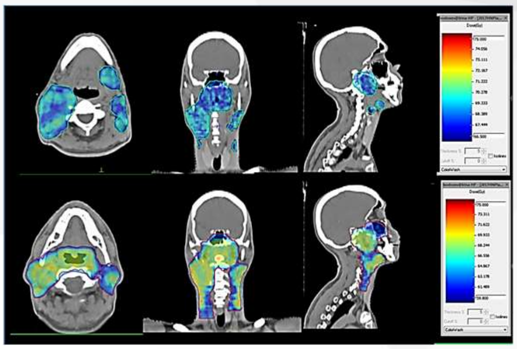
Name: **Irina Fotina**
Country: **Germany**
Hospital: **Self-Employed**
Technique: **IMRT**
Rank: **Top (Monaco)**
Job Title: **Medical Physicist**

Clinical
93.6/100

Name: **Charbel Attieh**
Country: **Bahrain**
Hospital: **King Hamad University Hospital**
Technique: **IMRT**
Rank: **Second Top (Monaco)**
Job Title: **Medical Physicist**

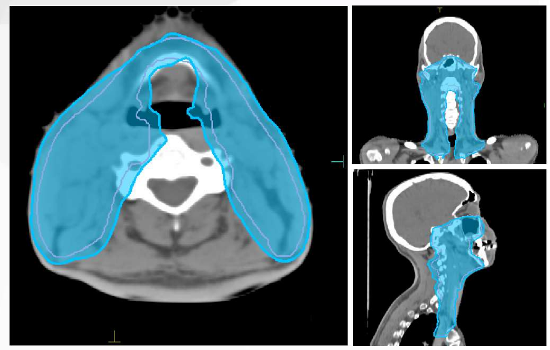
Plan Details:

Energy: 6 & 10MV , 9 Beams, Linac: Agility



Plan Details:

Energy: 6 & 10MV , 9 Beams, Linac: Versa HD



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9 Field IMRT Plan With Monaco and Monte Carlo

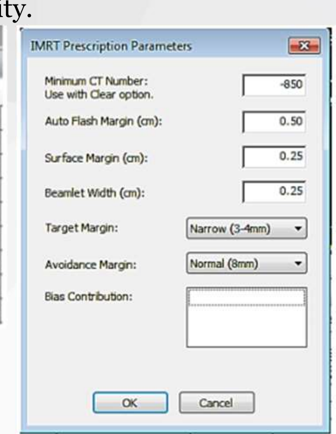
Irina FOTINA, PhD

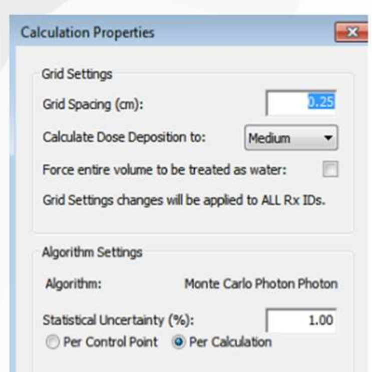
- Align iso-center with the PTV. (Common Sense)
- 5 Anterior beams of (6MV) and 4 Posterior beams (10 MV)
- Utilize appropriate margins for the target, beamlet and avoidance structures.
  - Improvement of Conformity Index is possible with increased beams, but it has limited effect on homogeneity.

Beams

Delete Parent Beams

Beam	Description	SSD (cm)	Gantry (deg)	Collimator (deg)	Couch (deg)
1	G0	92.41	0.0	0.0	0.0
2	G40	95.04	40.0	0.0	0.0
3	G80	95.25	80.0	0.0	0.0
4	G128	92.40	128.0	0.0	0.0
5	G165	92.41	165.0	0.0	0.0
6	G125	92.30	200.0	0.0	0.0
7	G238	91.85	238.0	0.0	0.0
8	G280	93.72	280.0	0.0	0.0
9	G320	94.50	320.0	0.0	0.0





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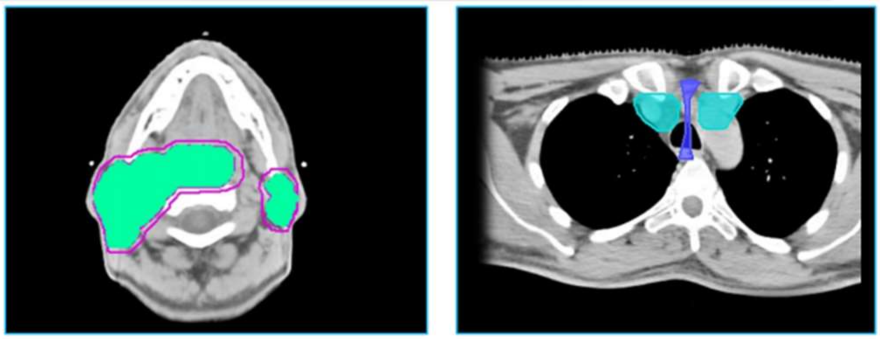
Contouring

Setup Tips:

- Monaco cannot handle "ring" type structures.
- Construct an optimized PTV with 3mm margin
- Create low dose structures



*Shell structure around PTV70 (**R1** = PTV70+3mm) is shown on the left image as purple line contour, **SEPARATE** structure for more conformal dose in the lower neck level is depicted on the right side in dark blue color.*

Optimization

Target EUD Cost function:

Example : PTV70
Target EUD = 70 Gy, Cell Sensitivity = 0.75
Underdose DVH = 66.5 Gy to 95%
Quadratic Overdose = 72 Gy RMS = 0.25 Gy

- Pareto mode - allows you to increase target priority for regions of Target-OAR conflict (brachial plexus in the PTV)
- OAR Sparing - Reduce power law exponent (PLE) in serial function
- Choose DVH resolution of 0.25 cm

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Pertinent Conclusions

1. **"Ikea effect" - We place a disproportionately high value on things we create.**

2. **The dosimetry Olympics – "A smooth sea never made a skilled sailor"**

3. **The best solutions are simple - "Simplicity is the ultimate sophistication"**

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Special Thanks To

Ahmad Mahmoud Nobah, M.Sc., DABR (Competition Founder)
Medical Physicist – Radiation Physics Section
King Faisal Specialist Hospital & Research Centre

Victor Gabriel Leanardo Alves, D.Sc.
Medical Physicist - RT Physicist, INCA, Brazil

Saad Aldelaijan. M.Sc.,
Medical Physicist – Radiation Physics Section
King Faisal Specialist Hospital & Research Centre

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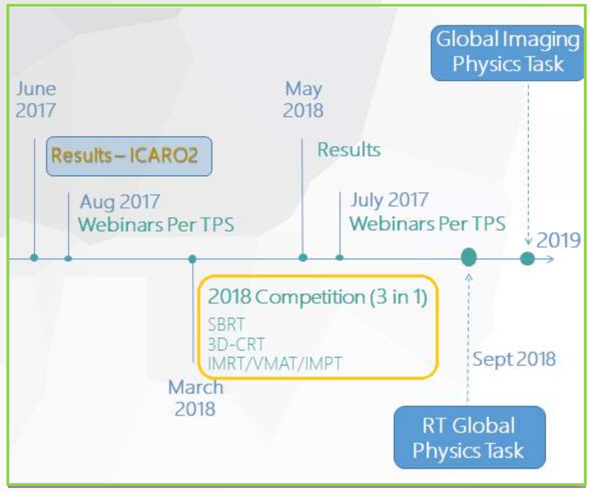
Join Us

RADIATION KNOWLEDGE



THANK YOU

END

THANK YOU