

Baş – Boyun Kanserlerinde Planlama Tecrübesi (IMRT)

Gökhan AYDIN

Acıbadem Maslak Hastanesi

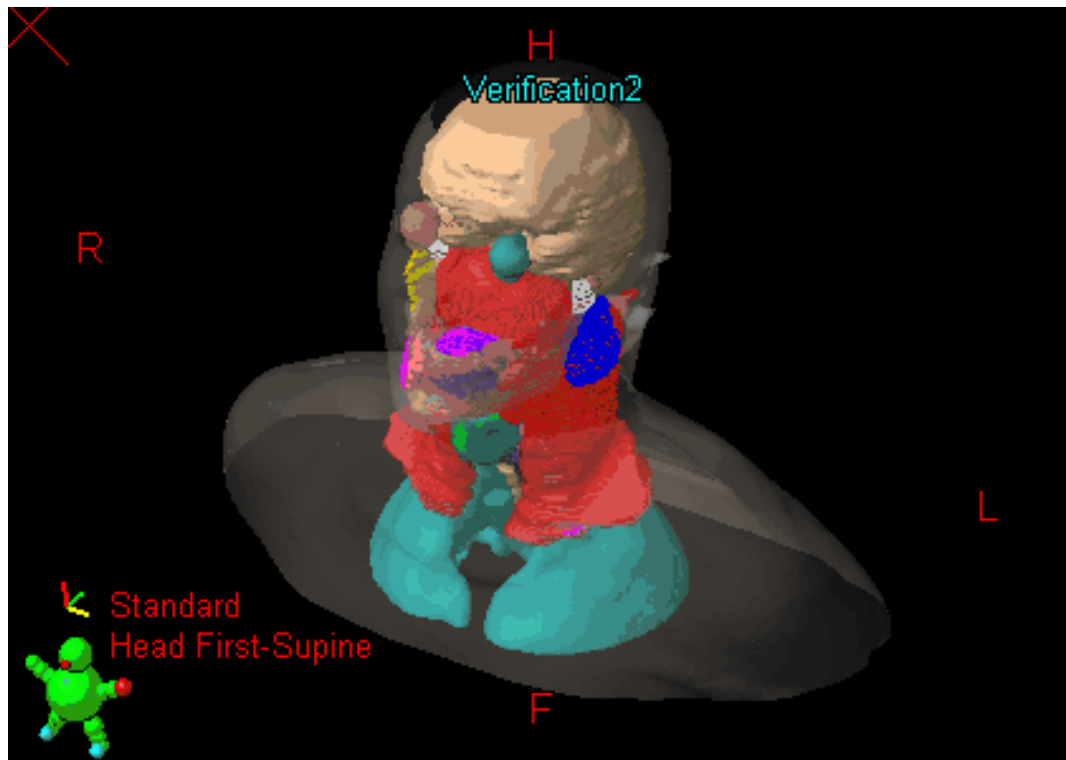
Merhaba IMRT (2008 -)

- Varian Trilogy Lineer hızlandırıcı (120 MLC)
- Dr Enis Özyar'ın dayanılmaz baskısı ☺
- IMRT'den çok fayda sağlayabilecek bir hasta
- 2. IMRT hastası nazofarenks ca

İşe başlarken,



Konturlama

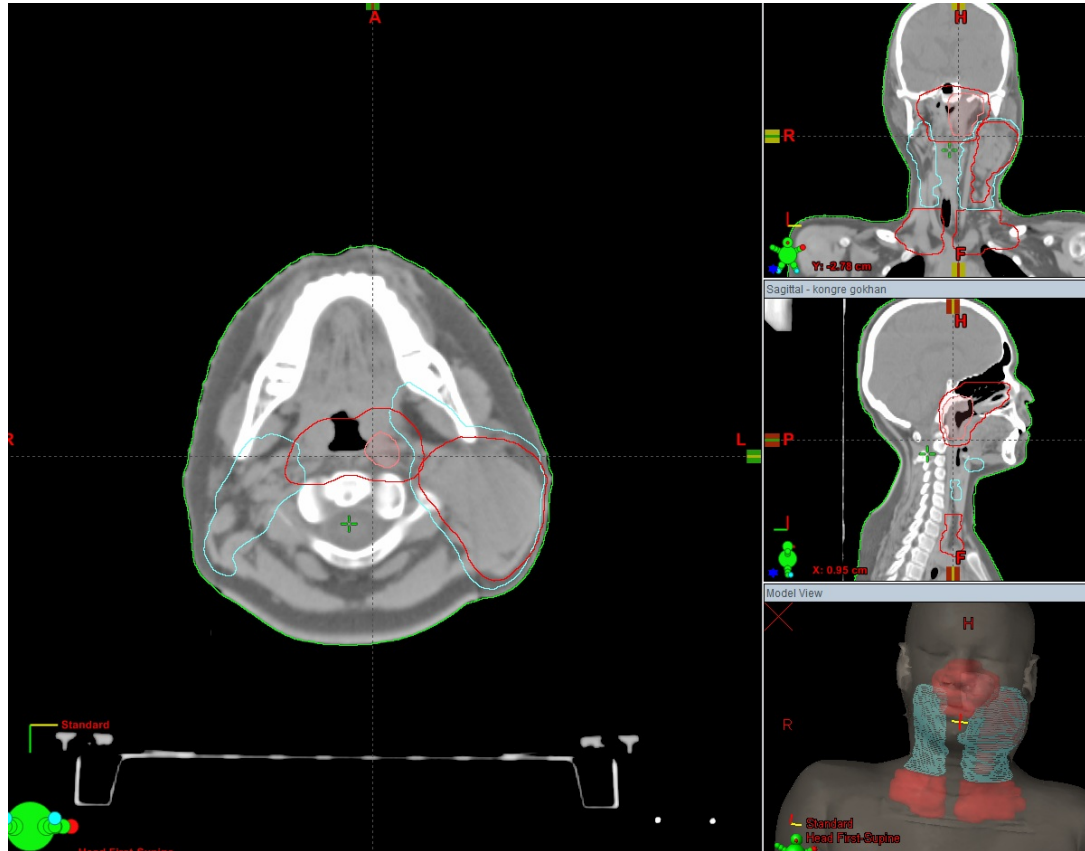


Neler Kontrolanmış

- ☐ kongre
- ☐ 56
- ☐ 60
- ☐ 70
- ☐ B-P
- ☒ BODY
- ☐ Brain
- ☐ Brain stem
- ☐ Brain stem 3mm
- ☐ CTV56-N-L
- ☐ CTV56-N-R
- ☐ CTV56-N-Total
- ☐ CTV60-N-L
- ☐ CTV60-N-R
- ☐ CTV60-N-total
- ☐ CTV60-T
- ☐ Dose 6600[cGy]
- ☐ Eye L
- ☐ Eye R
- ☐ FANTOM
- ☐ GTV69.9-N
- ☐ GTV69.9-T
- ☐ Hipofiz
- ☐ Kiazma
- ☐ Kohlea L
- ☐ Kohlea R

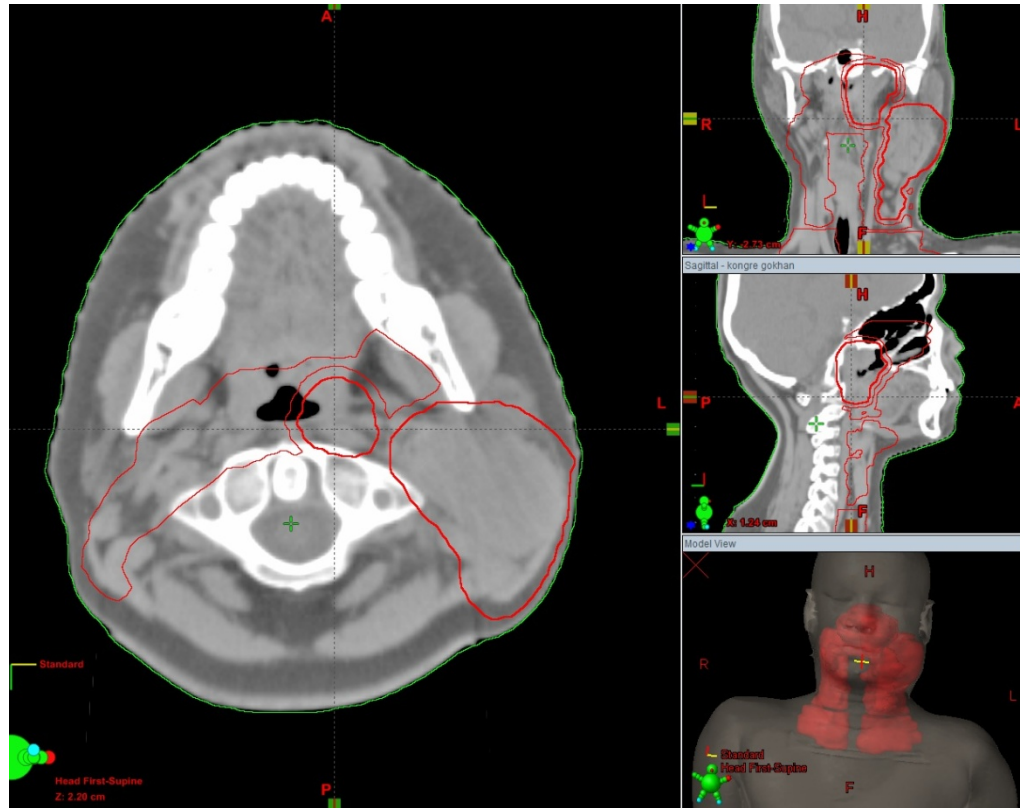
- ☐ Konstruktör kas
- ☐ Larenks
- ☐ Lens L
- ☐ Lens R
- ☐ Lungs
- ☐ Mandibula
- ☐ NET_60
- ☐ Optic nerve L
- ☐ Optic nerve R
- ☐ Oral cavity
- ☐ Ozeagus
- ☐ Parotis L
- ☐ Parotis R
- ☐ PTV56-N-Total
- ☐ PTV60-N-total
- ☐ PTV60-T
- ☐ PTV69.9-N
- ☐ PTV70-T
- ☐ RING56
- ☐ RING60
- ☐ RING70
- ☐ Spinal cord
- ☐ Spinal cord 5mm
- ☐ SubmandGland R
- ☐ TOTAL

Tipik Bař – Boyun Hedef Konturu



Özel bir risk yok ise ciltten 3mm crop

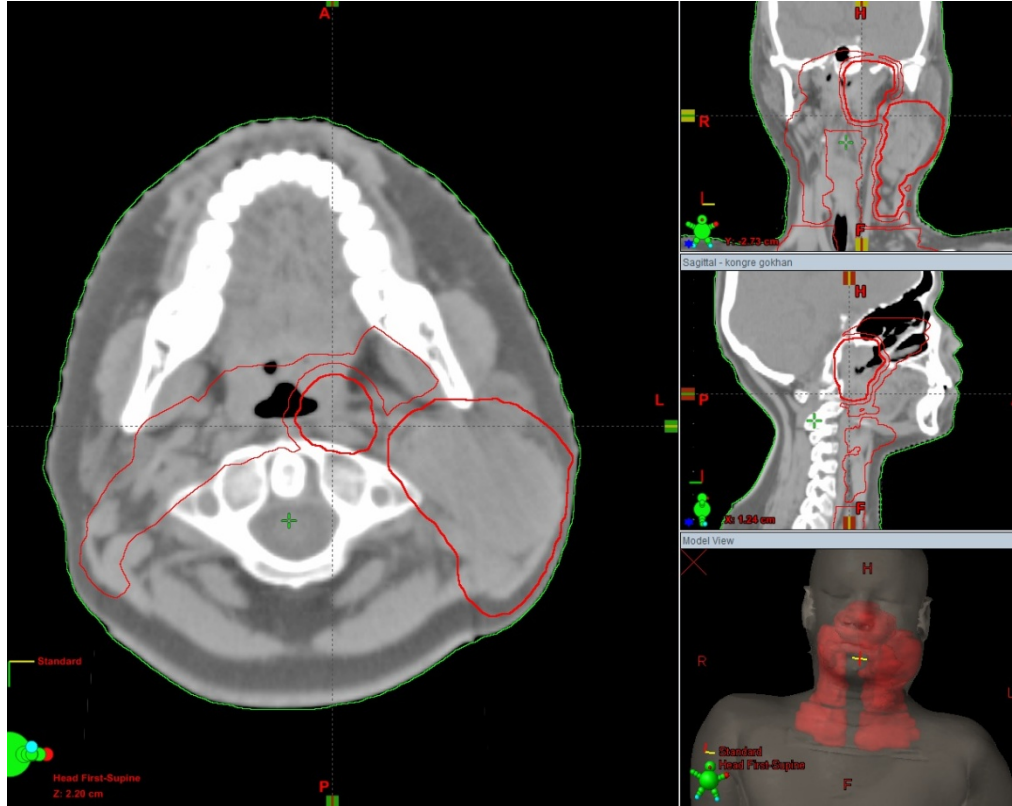
Ekstra Yapılar (optimizasyon hedefleri)



**Hedeflere üst/alttan 2mm, diğerlerinden 1mm marj
Birbirlerinden 3mm crop**

Ekstra Yapılar (optimizasyon hedefleri)

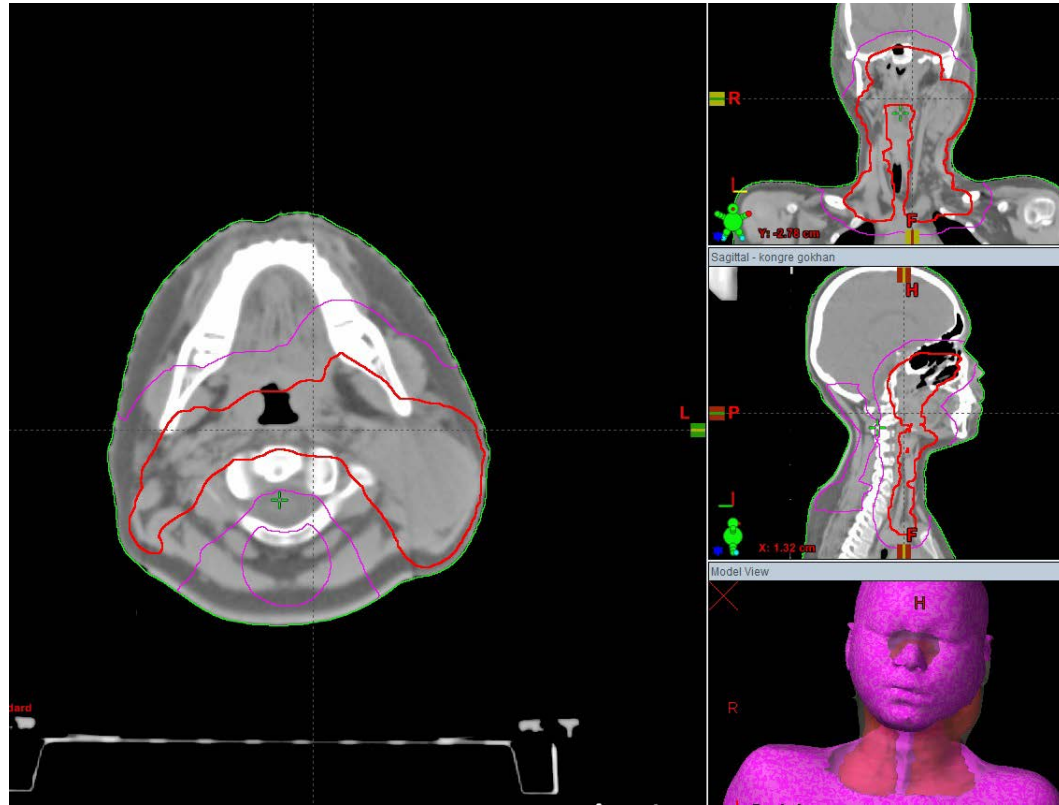
**Optimizasyon
iyi,
hesaplama
kötü hedef
kapsanması**



**DVH'te sıcak
dozu
azalttığımızdan
emin olmak
için**

**Hedeflere üst/alttan 2mm, diğerlerinden 1mm marj
Birbirlerinden 3mm crop**

Ekstra Yapılar (aslında olmayan yapılar)

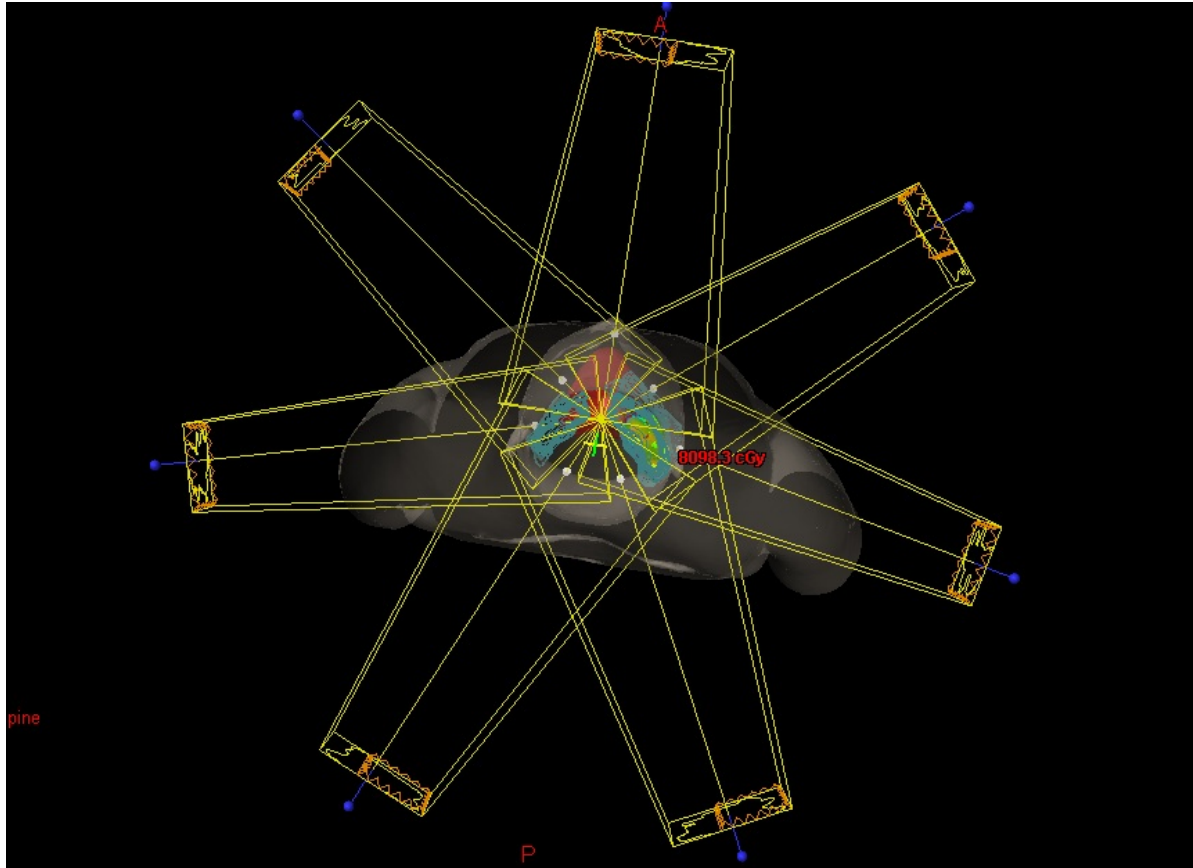


**Bize her yer kritik !
Yüksek dozlar kontrol altında**

Ekstra Yapılar (kritikler)

- Spinal kord + beyin sapı + 3/5mm
- Kiazma, lens, optik sinir gibi küçük hacimli yapılarda marj kullanılabilir
- Parotislerde overlap hacim, Hedef – Parotis veya Parotis – Hedef gibi tanımlamalar **BİTTİ**

Alan Yönleri



Homojen dağılmış 51'lik 7 alan
0 / 51 / 102 / 153 / 204 / 255 / 306

Plana Başlarken,

Machine/Energy	MLC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	0.0	0.0	0.0	None
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	51.0	0.0	0.0	None
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	102.0	0.0	0.0	None
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	153.0	0.0	0.0	None
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	204.0	0.0	0.0	None
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	255.0	0.0	0.0	None
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	306.0	0.0	0.0	None

Field X [cm]	X1 [cm]	X2 [cm]	Field Y [cm]	Y1 [cm]	Y2 [cm]	X [cm]	Y [cm]	Z [cm]	SSD [cm]
19.5	+9.4	+10.1	22.8	+11.8	+11.0	0.13	-2.48	-1.10	91.8
16.2	+6.7	+9.5	22.5	+12.0	+10.5	0.13	-2.48	-1.10	94.3
12.5	+6.5	+6.0	22.0	+12.0	+10.0	0.13	-2.48	-1.10	92.0
19.0	+9.4	+9.6	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.0
18.6	+10.1	+8.5	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.1
13.2	+7.4	+5.8	22.0	+12.0	+10.0	0.13	-2.48	-1.10	93.8
16.5	+8.8	+7.7	22.8	+12.0	+10.8	0.13	-2.48	-1.10	94.8

TOPLAM'a göre merkezi otomatik seçim

Alanları ve yönleri seçim

300DR / 6MV

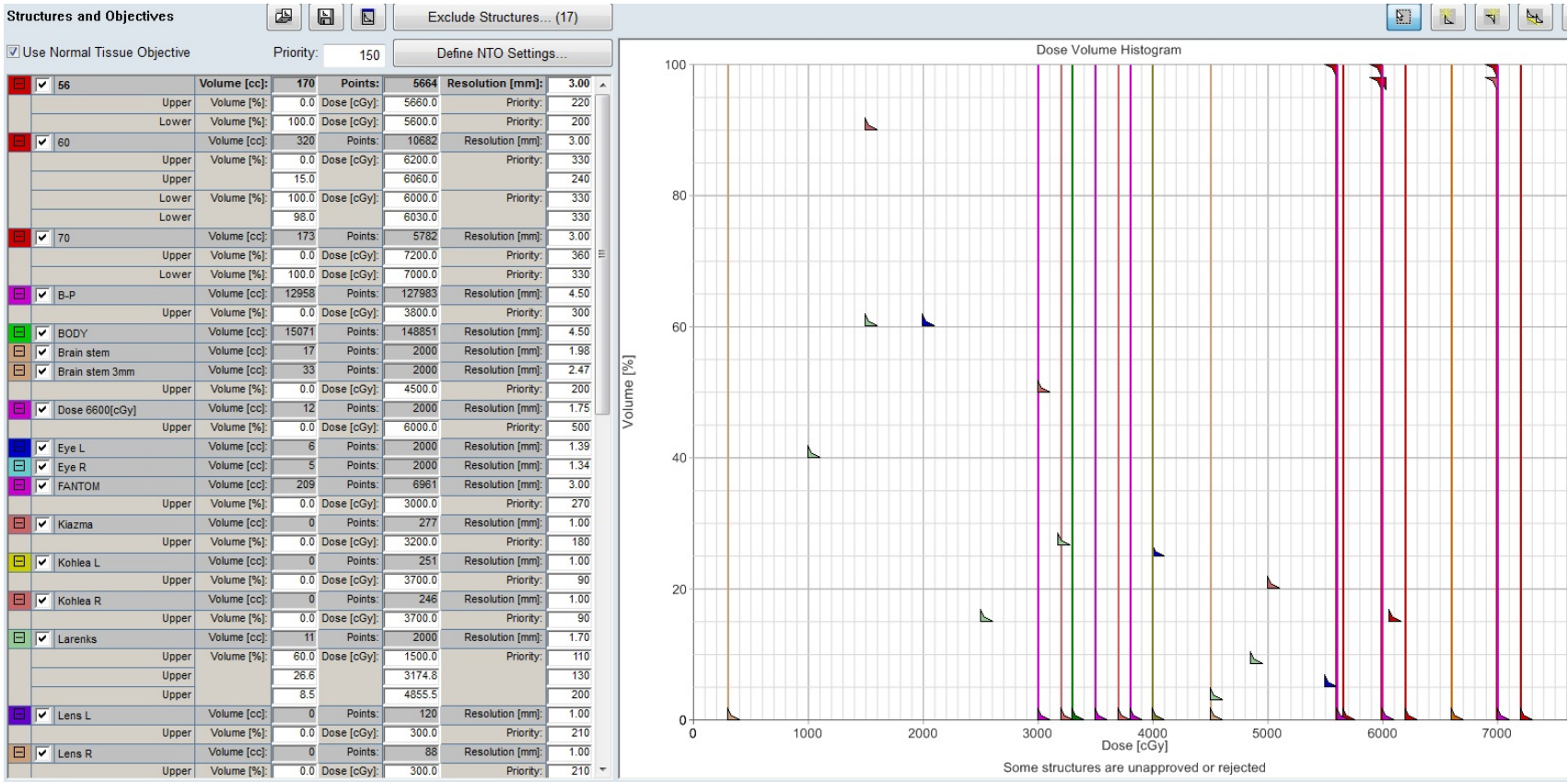
Alan boyutları optimizasyondan sonra otomatik oluştu

Doz Tanımlaması

Simultane integrale boost

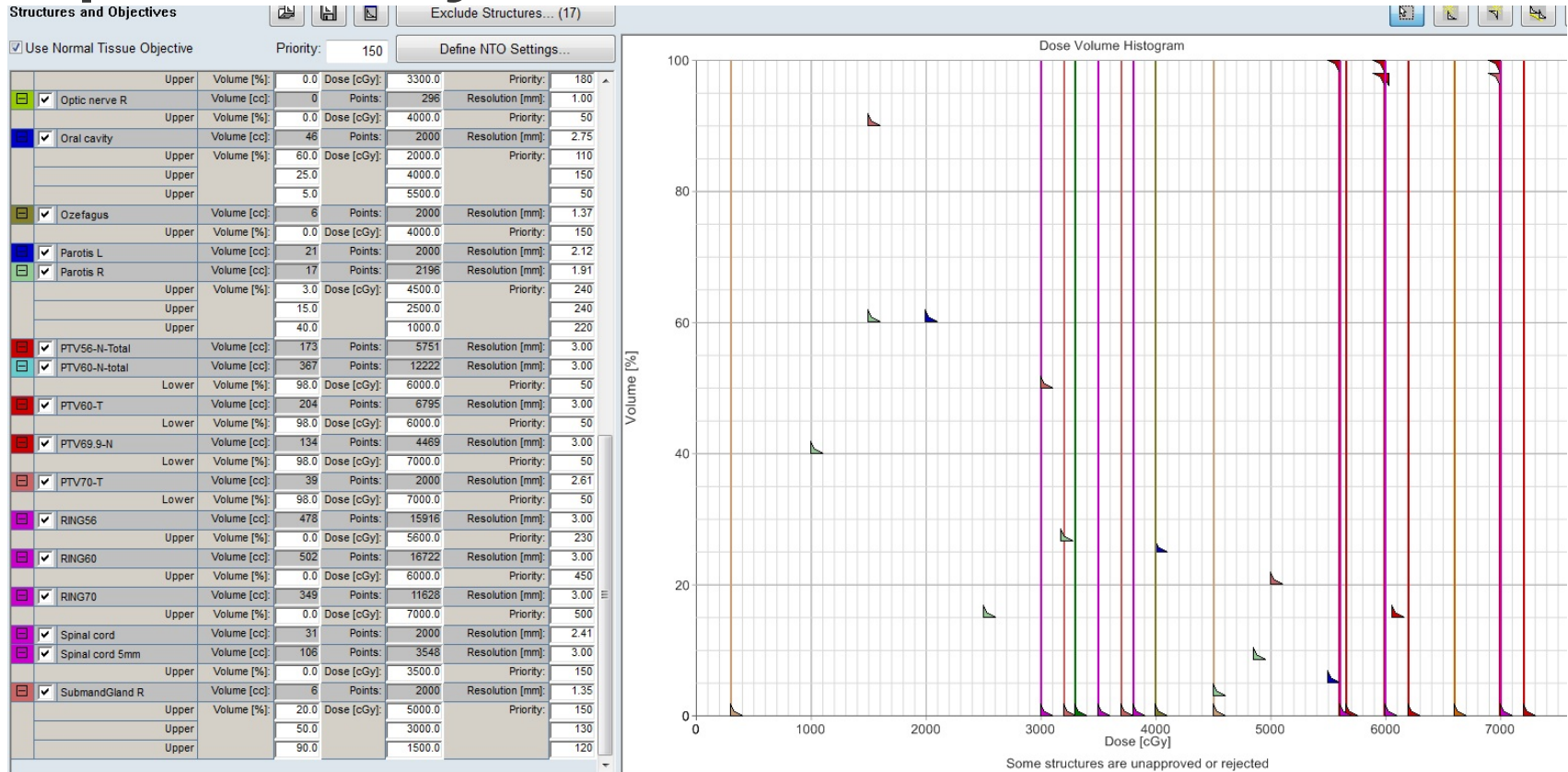
56 Gy	170	=	56 Gy
60 Gy	182	X 33 =	60 Gy
70 Gy	212	=	70 Gy

Optimizasyon



Öncelikleri hedeflerde biraz yüksek, kritiklerde eşit ve 50'de bırakıyorum
İterasyonlardan aldığım yanıtı göre küçük adımlarla arttırıyorum

Optimizasyon

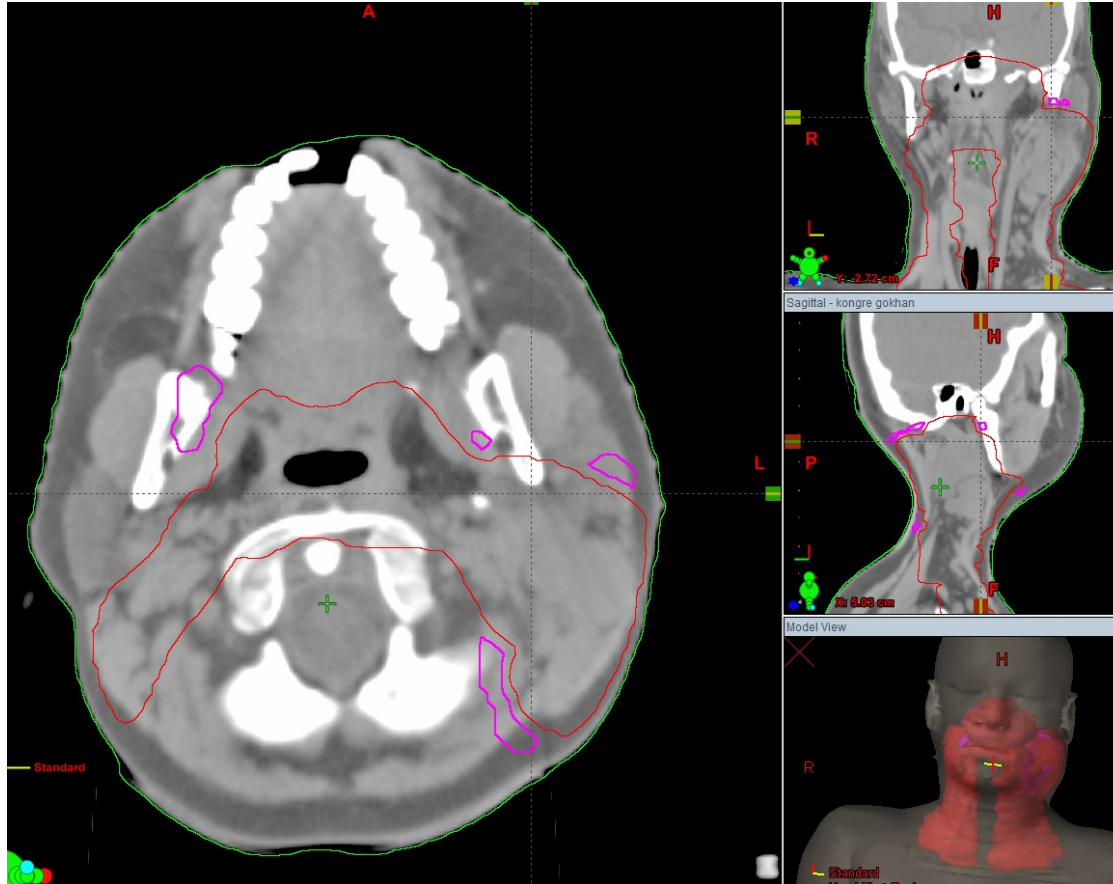


Çakışan yapıları, öncelik değerlerine göre kullanıyorum, hedefte büyük Sıcak doz tarafının öncelikleri büyük Gerçek yapılar yerine, oluşturduğum yapıları kullanıyorum

Hesaplama

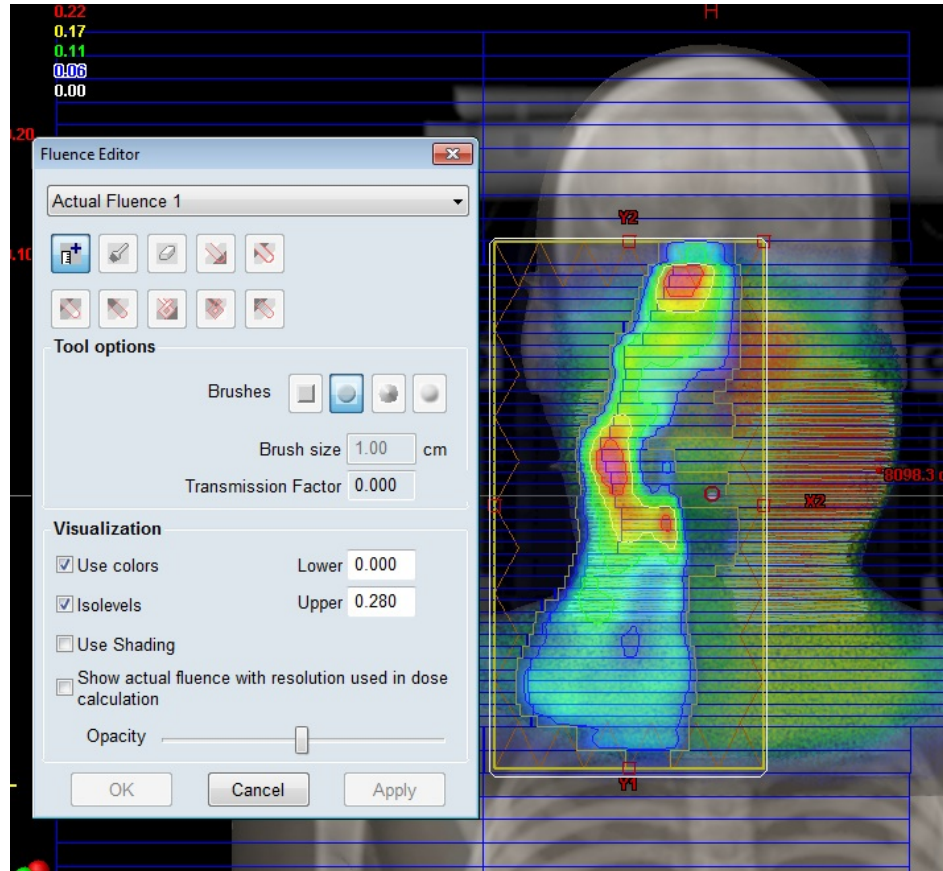
- Sliding window
- Algoritma AAA, optimizasyon DVO'su ile uyumsuz
- Reoptimizasyon Gerekli Mİ?
- Akı haritası optimize edilir Mİ?

ReOptimizasyon (istenmeyen dozlar)



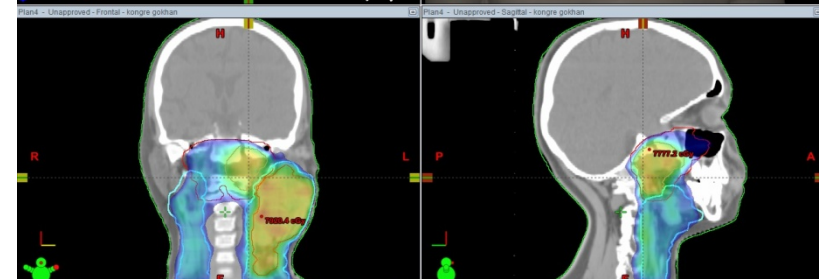
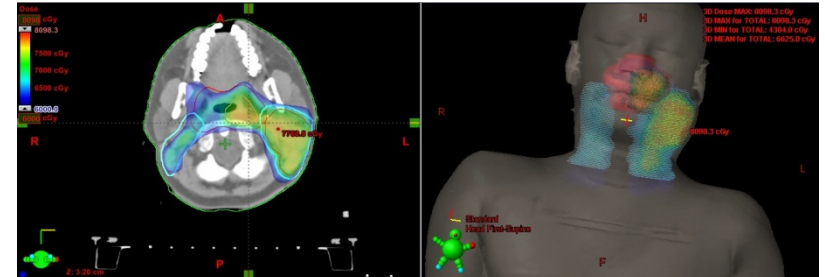
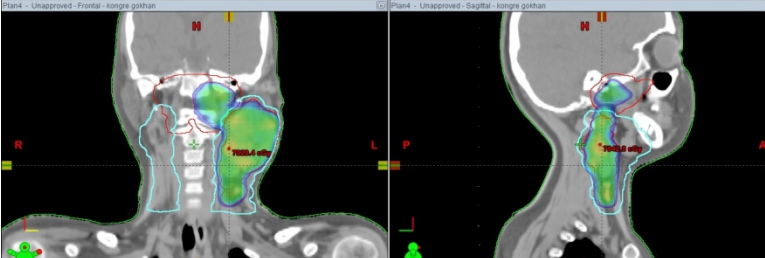
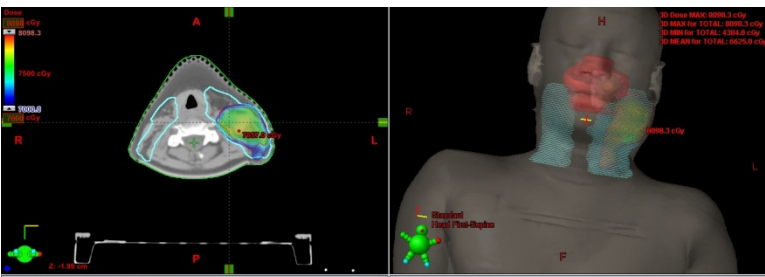
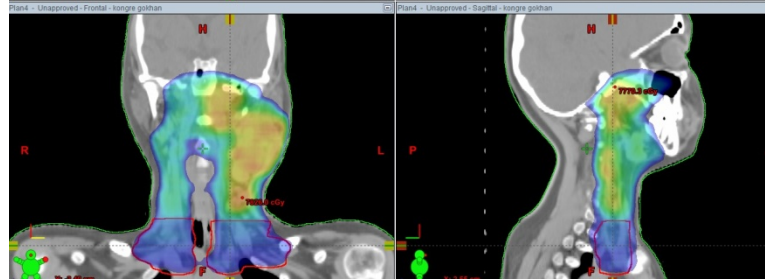
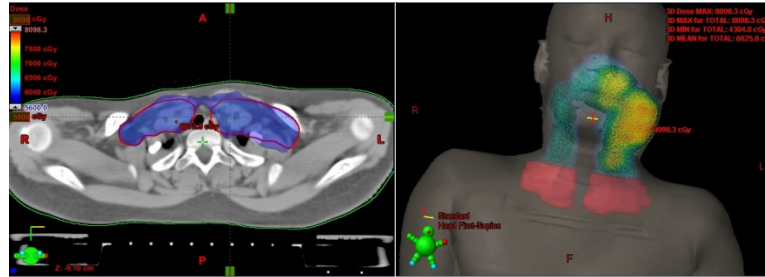
**Herşeye rağmen oluşan sıcakları organa çevir,
ikinci optimizasyonda kullan**

Fluence Editing



**Doz haritasındaki keskin doz geişlerini abartmadan azalt.
Doz dağılımı deėişmez, MU azalır**

Değerlendirme (hedefin kapsanması)

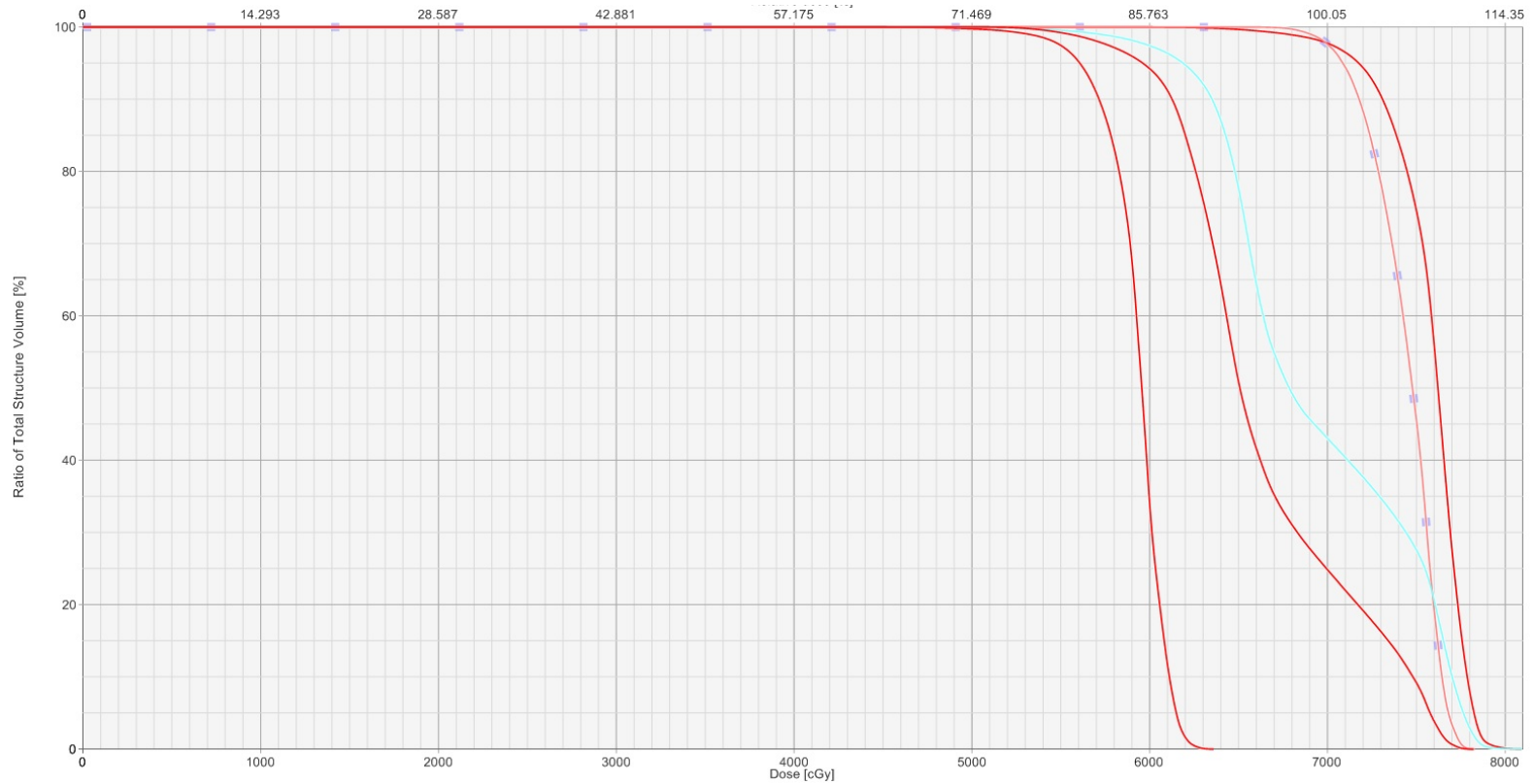


RADIATION THERAPY ONCOLOGY GROUP

RTOG 0225

V95	Hedef dozu
<%20	77 Gy (%110) ve >
<%5	80.5 ve >
<%1	65 Gy (%93) ve <
<%1 veya <1 cc Non PTV70 bölgesi	77 Gy (%110) ve >

Değerlendirme (Hedefler)



Dose Prescription		Field Alignments	Plan Objectives	Optimization Objectives	Dose Statistics	Calculation Models	Plan Sum				
DVH Line	Structure	Approval Status	Plan	Course	Volume [cm ³]	Dose Cover[%]	Sampling Cover[%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]	
	PTV56-N-Total	Approved	Plan4 #	kongre test	172.5	100.0	100.1	4304.0	6364.3	5928.1	
	PTV60-N-Total	Approved	Plan4 #	kongre test	366.7	100.0	100.0	4550.1	8098.3	6952.5	
	PTV60-T	Approved	Plan4 #	kongre test	203.9	100.0	100.0	4925.5	7826.9	6645.0	
	PTV69.9-N	Approved	Plan4 #	kongre test	134.1	100.0	100.0	5777.1	8098.3	7575.8	
	PTV70-T	Approved	Plan4 #	kongre test	39.5	100.0	100.1	6506.4	7826.9	7439.8	

Değerlendirme (Kritikler)

View	DVH Line	Structure	Approval Status	Plan	Course	Volume [cm ³]	Dose Cover[%]	Sampling Cover[%]	Min Dose [cGy]	Max Dose [cGy]	Mean Dose [cGy]	
☐		BODY	Approved	Plan4 #	kongre test							
☐		Brain	Approved	Plan4 #	kongre test							
☒		Brain stem	Approved	Plan4 #	kongre test	17.2	100.0	100.1	1656.0	5140.3	3309.9	
☐		Brain stem 3mm	Approved	Plan4 #	kongre test							
☐		Dose 0000000000	Approved	Plan4 #	kongre test							
☒		Eye L	Approved	Plan4 #	kongre test	6.0	100.0	100.1	291.2	3400.9	880.7	
☒		Eye R	Approved	Plan4 #	kongre test	5.4	100.0	100.0	268.9	2628.0	715.8	
☐		FANTOM	Approved	Plan4 #	kongre test							

Critical Normal Structures

DVH's must be generated for all critical normal structures and the unspecified tissues. Dose constraints to normal tissues will be as follows:

Brainstem, optic nerves, chiasm
Spinal cord

54 Gy or 1% of the PTV cannot exceed 60 Gy
45 Gy or 1 cc (if 1% is used, depends on length of the cord outlined) of the PTV cannot exceed 50 Gy

Mandible and T-M joint
Temporal lobes

70 Gy or 1 cc of the PTV cannot exceed 75 Gy
60 Gy or 1 % of the PTV cannot exceed 65 Gy

Unspecified tissue outside the targets: $\leq 100\%$ of the dose prescribed to PTV₇₀. No more than 5% of the non-target tissue can receive greater than 70 Gy. **Participants are strongly encouraged to remain within these limits.**

Değerlendirme (Kritikler)

☐	Hipofiz	Approved	Plan4 #	kongre test							
☒	Kiazma	Approved	Plan4 #	kongre test	0.3	100.0	100.5	1880.5	2895.1	2472.7	
☐	Kohlea L	Approved	Plan4 #	kongre test	0.3	100.0	99.7	2936.0	5696.0	4377.3	
☐	Kohlea R	Approved	Plan4 #	kongre test	0.3	100.0	100.5	2538.1	4990.2	3848.1	
☐	Konstruktor kas	Approved	Plan4 #	kongre test							
☒	Larenks	Approved	Plan4 #	kongre test	10.9	100.0	100.1	1998.0	6387.7	3673.8	
☐	Lens L	Approved	Plan4 #	kongre test	0.1	100.0	100.7	625.5	935.5	728.7	
☐	Lens R	Approved	Plan4 #	kongre test	0.1	100.0	100.0	812.6	1319.3	1038.3	
☐	Lungs	Approved	Plan4 #	kongre test							
☐	Mandibula	Approved	Plan4 #	kongre test							
☐	NET_60	Approved	Plan4 #	kongre test							
☐	Optic nerve L	Approved	Plan4 #	kongre test							
☐	Optic nerve R	Approved	Plan4 #	kongre test							
☒	Oral cavity	Approved	Plan4 #	kongre test	46.4	100.0	100.0	1771.6	6871.2	3863.4	
☐	Ozefagus	Approved	Plan4 #	kongre test							

Other normal structures: Dose constraints for other normal structures outlined are suggested below, but will be considered LOW PRIORITY. THESE ARE ONLY SUGGESTIONS AND THE CONSTRAINTS SHOULD NOT COMPROMISE THE GTV OR CTV COVERAGE:

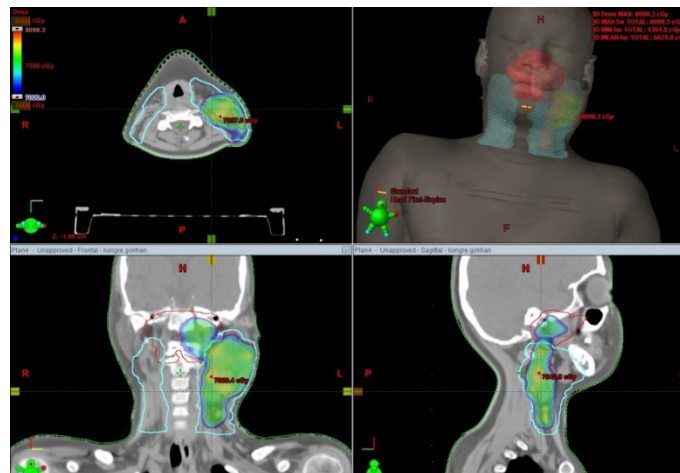
Tongue:	55 Gy or 1 % of the PTV cannot exceed 65 Gy
Inner/middle ears	mean dose less than 50 Gy
Eyes	mean dose less than 35 Gy
Lens	as low as possible
Glottic Larynx	mean dose less than 45 Gy

Değerlendirme (Kritikler)

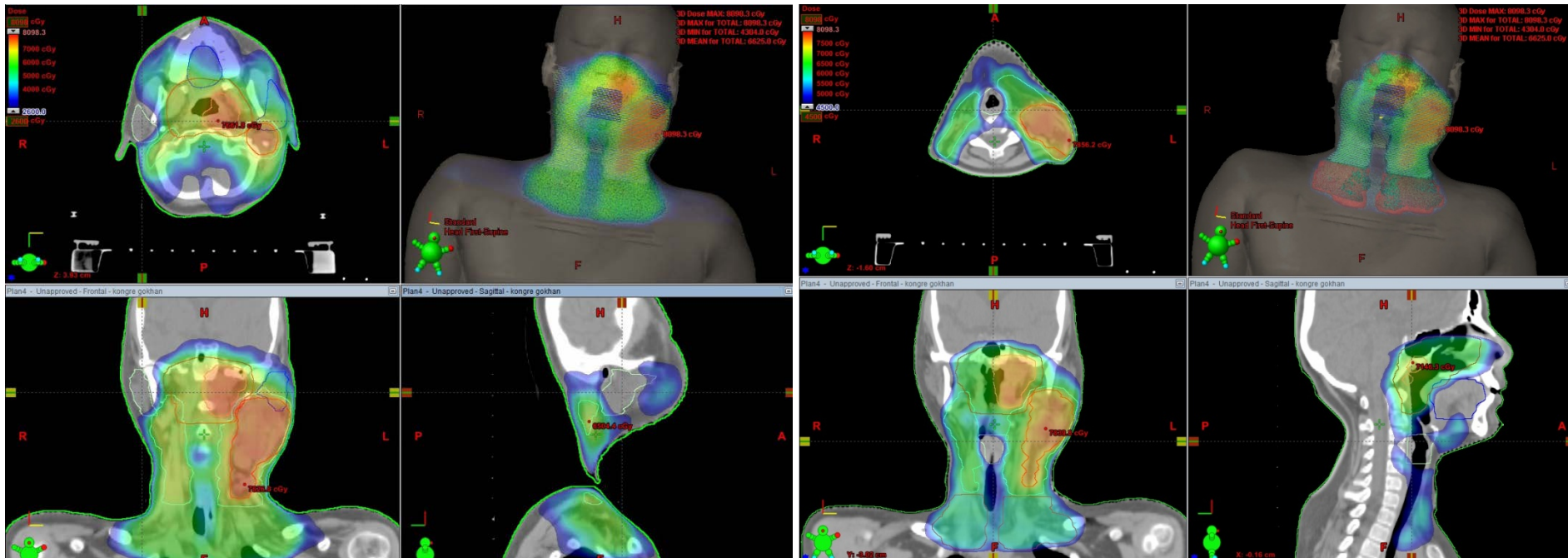
☒	Parotis L	Approved	Plan4 #	kongre test	21.2	100.0	100.0	2124.8	7788.0	5227.5
☒	Parotis R	Approved	Plan4 #	kongre test	17.0	100.0	99.9	950.9	6478.4	2223.9
☐	RING56	Approved	Plan4 #	kongre test						
☐	RING60	Approved	Plan4 #	kongre test						
☐	RING70	Approved	Plan4 #	kongre test						
☒	Spinal cord	Approved	Plan4 #	kongre test	31.3	100.0	99.9	7.3	4237.1	1749.9

Parotid glands: Mean dose ≤ 26 Gy (*should be achieved in at least one gland*) or at least 20 cc of the combined volume of both parotid glands will receive < 20 Gy or at least 50% of the gland will receive < 30 Gy (*should be achieved in at least one gland*).

Submandibular/sublingual glands and oral cavity: Reduce the dose as much as possible.



Doz Dağılımı 26/45Gy (2960/1526cc)



Zaman

Konturlama 30-40 dk

Machine/Energy	MLC	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]	SSD [cm]	MU
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	0.0	0.0	0.0	None	19.5	+9.4	+10.1	22.8	+11.8	+11.0	0.13	-2.48	-1.10	91.8	225
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	51.0	0.0	0.0	None	16.2	+6.7	+9.5	22.5	+12.0	+10.5	0.13	-2.48	-1.10	94.3	197
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	102.0	0.0	0.0	None	12.5	+6.5	+6.0	22.0	+12.0	+10.0	0.13	-2.48	-1.10	92.0	118
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	153.0	0.0	0.0	None	19.0	+9.4	+9.6	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.0	213
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	204.0	0.0	0.0	None	18.6	+10.1	+8.5	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.1	204
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	255.0	0.0	0.0	None	13.2	+7.4	+5.8	22.0	+12.0	+10.0	0.13	-2.48	-1.10	93.8	119
RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	306.0	0.0	0.0	None	16.5	+8.8	+7.7	22.8	+12.0	+10.8	0.13	-2.48	-1.10	94.8	217

Optimizasyon 30-40 dk

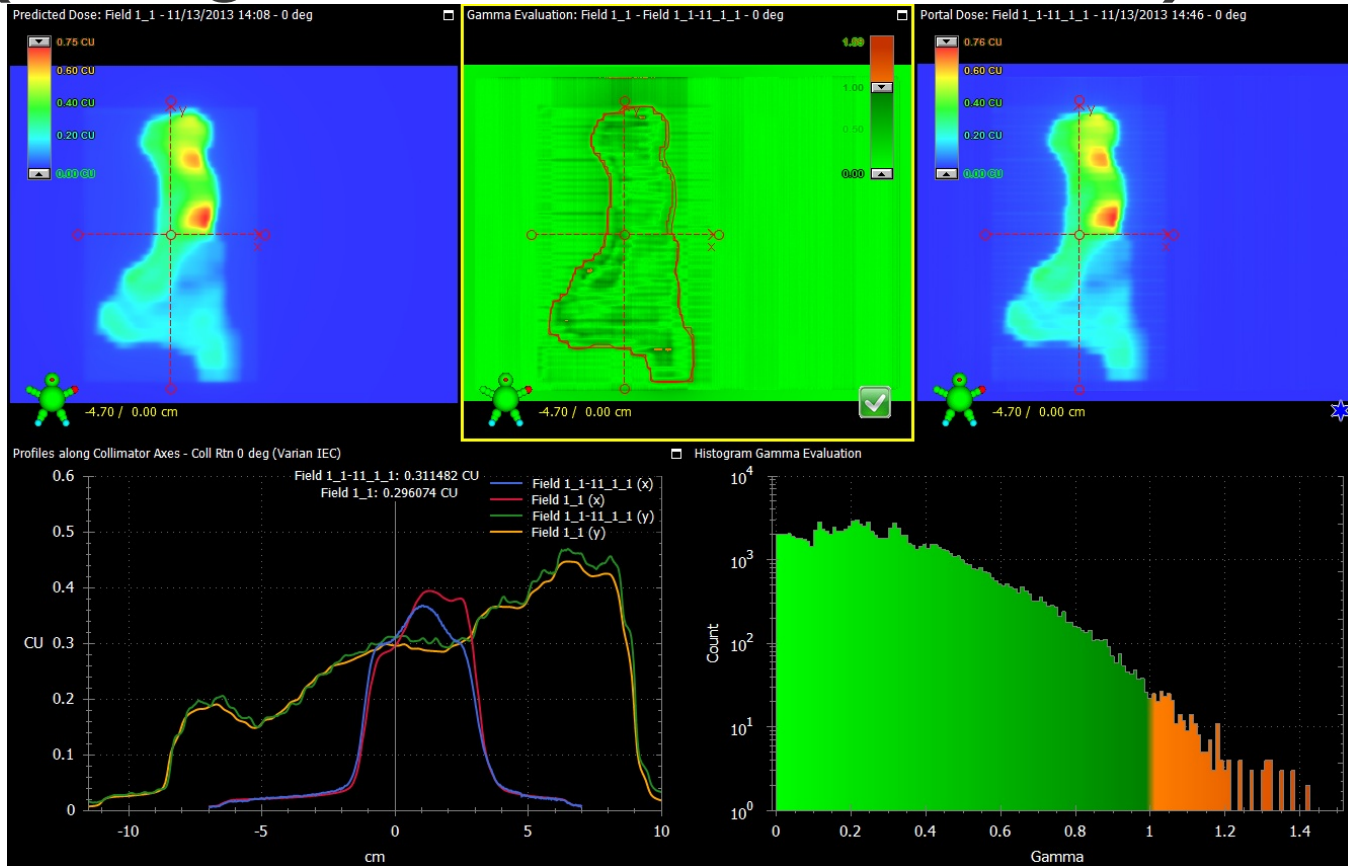
ReOptimizasyon 15-20 dk

Group	Field ID	Technique	Machine/Energy	MLC	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]	SSD [cm]	MU
☒	Field 1_1	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	0.0	0.0	0.0	None	11.6	+9.4	+2.2	22.8	+11.8	+11.0	0.13	-2.48	-1.10	91.8	135
☒	Field 1_2	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	0.0	0.0	0.0	None	11.6	+1.5	+10.1	22.8	+11.8	+11.0	0.13	-2.48	-1.10	91.8	89
☒	Field 2_1	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	51.0	0.0	0.0	None	11.2	+6.7	+4.5	22.5	+12.0	+10.5	0.13	-2.48	-1.10	94.3	105
☒	Field 2_2	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	51.0	0.0	0.0	None	8.9	-0.6	+9.5	22.5	+12.0	+10.5	0.13	-2.48	-1.10	94.3	92
☒	Field 3	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	102.0	0.0	0.0	None	12.5	+6.5	+6.0	22.0	+12.0	+10.0	0.13	-2.48	-1.10	92.0	118
☒	Field 4_1	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	153.0	0.0	0.0	None	11.3	+9.4	+1.9	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.0	121
☒	Field 4_2	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	153.0	0.0	0.0	None	11.4	+1.8	+9.6	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.0	92
☒	Field 5_1	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	204.0	0.0	0.0	None	11.8	+10.1	+1.7	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.1	113
☒	Field 5_2	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	204.0	0.0	0.0	None	10.5	+2.0	+8.5	21.8	+11.8	+10.0	0.13	-2.48	-1.10	94.1	91
☒	Field 6	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	255.0	0.0	0.0	None	13.2	+7.4	+5.8	22.0	+12.0	+10.0	0.13	-2.48	-1.10	93.8	119
☒	Field 7_1	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	306.0	0.0	0.0	None	7.5	+8.8	-1.3	22.8	+12.0	+10.8	0.13	-2.48	-1.10	94.8	88
☒	Field 7_2	STATIC-I	RAPIDARC MSLK - 6X	Dose Dynamic	1.000	Varian IEC	306.0	0.0	0.0	None	12.9	+5.2	+7.7	22.8	+12.0	+10.8	0.13	-2.48	-1.10	94.8	129

QA hazırla, ölç, değerlendir 30-40 dk

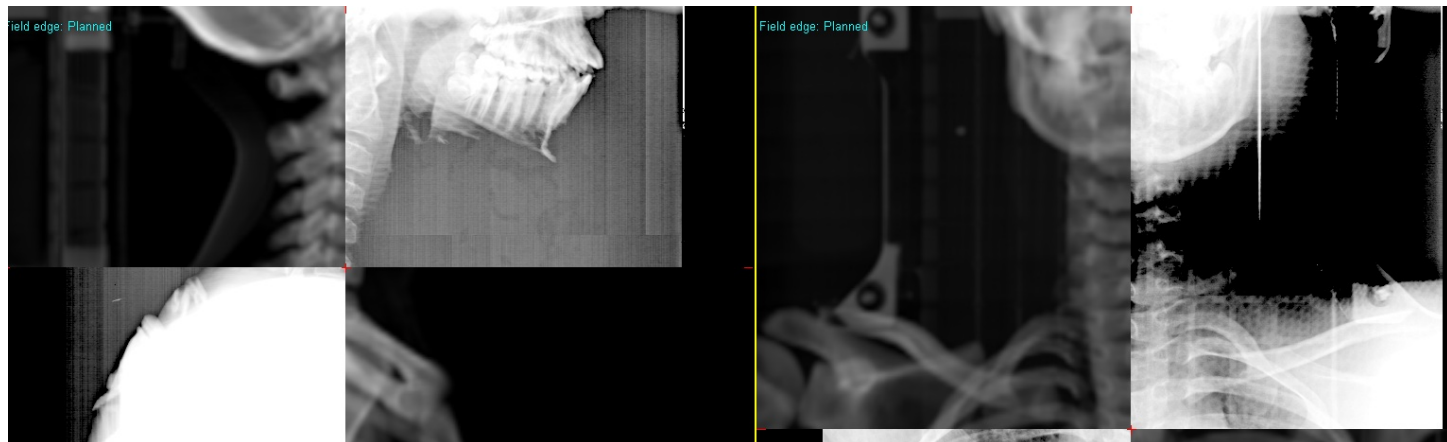
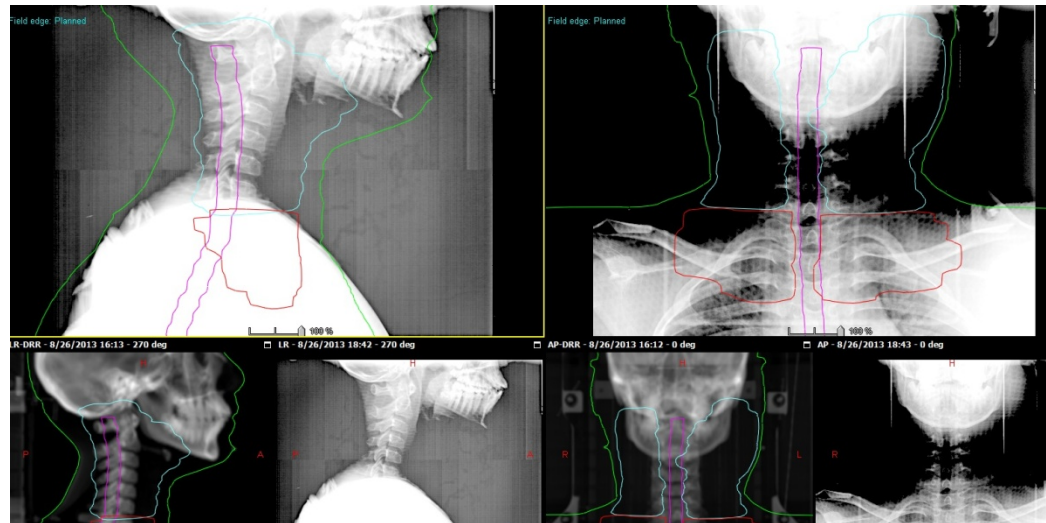
Tedavi 20-25dk

QA (2D gama analizi / EPID)

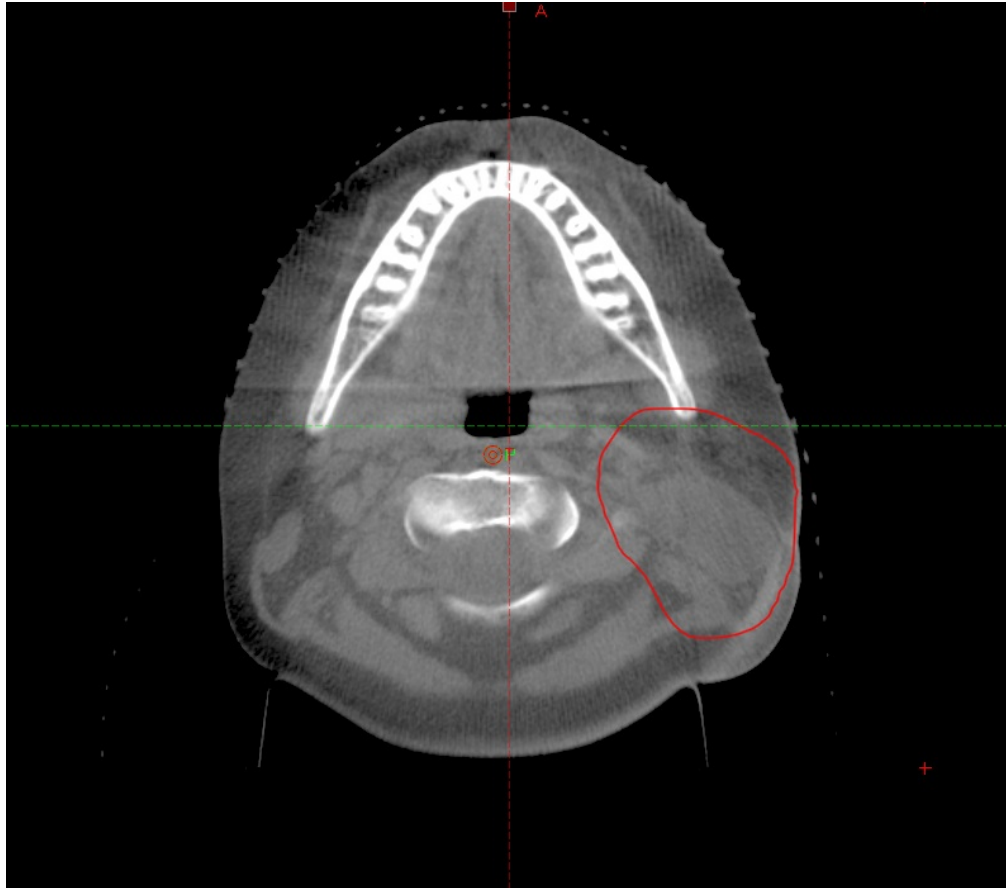


**İşin başında point te ölçüyorduk, yaklaşık 250 hasta sonra bıraktık
Makine bazlı MLC testleri de ekledik**

IGRT



Adaptif RT

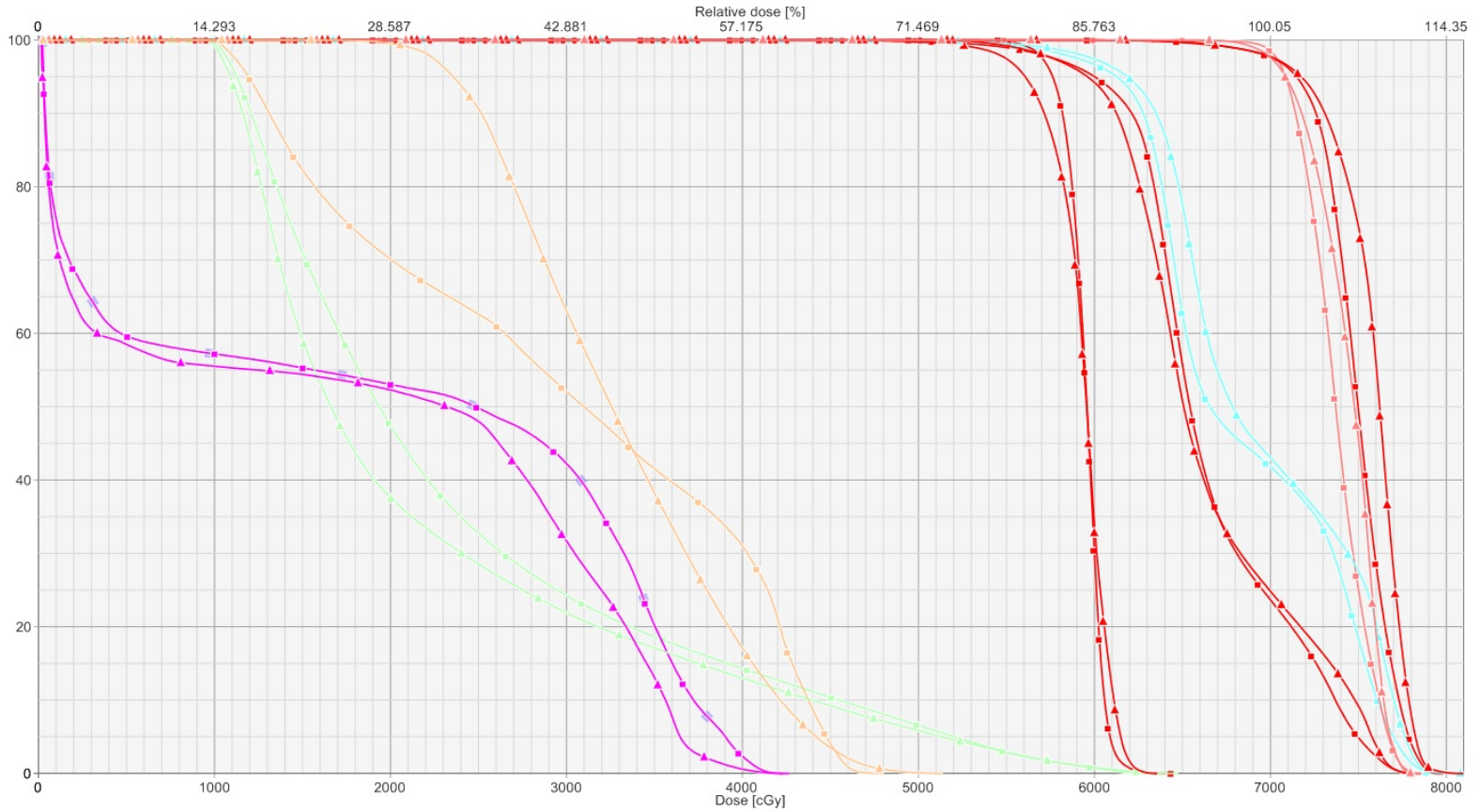


3. Haftadan sonra anlamlı ancak küçülen hedef ve değişen volümlerin yeniden tanımlanması zor

IMRT vs VMAT tecrübesi

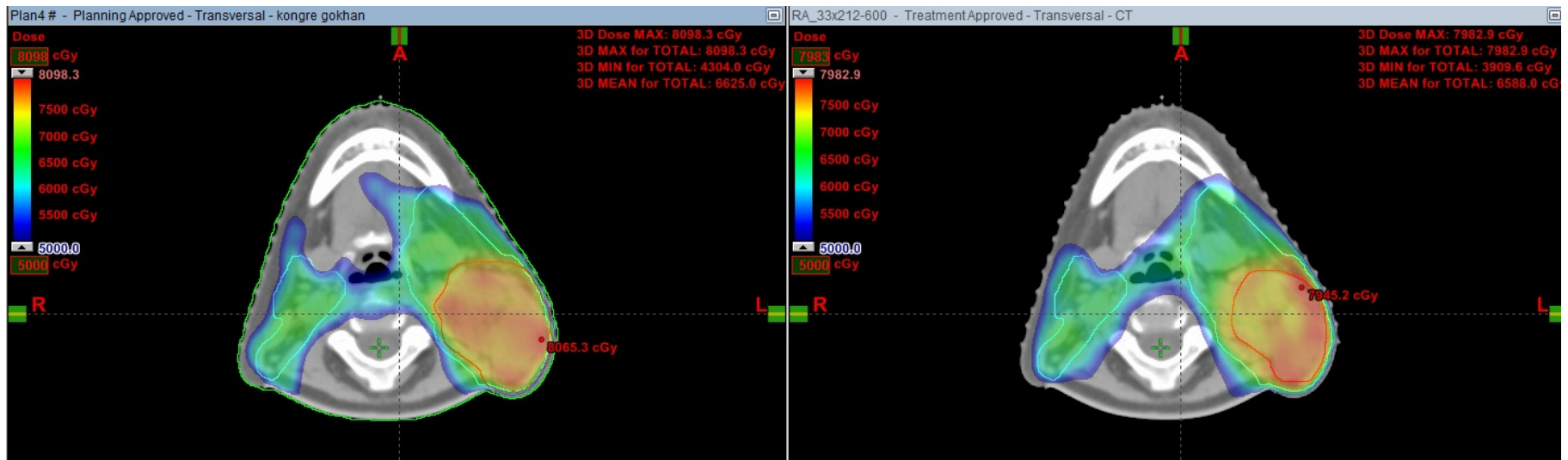
- Version 8.6 ile VMAT pratik değildi
- Yaklaşık 2 yıldır VMAT standart olma yolunda
- VMAT ile olmayan IMRT ile ok
- Planlama süresi EŞİT
- $VMAT\ MU = IMRT\ MU / 3$
- $VMAT\ Tedavi = IMRT\ Tedavi / 4$
- QA süresi EŞİT

IMRT vs VMAT

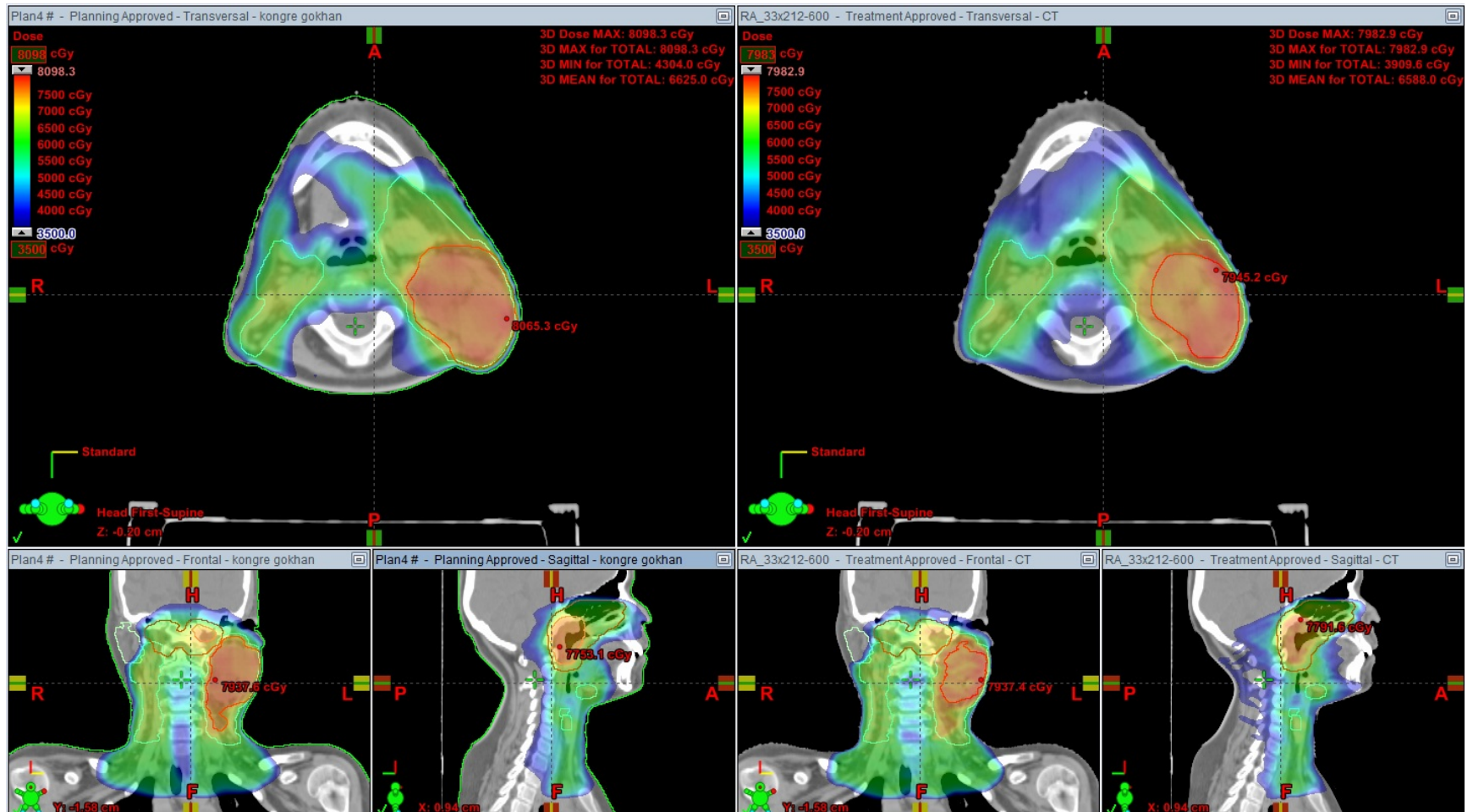


**VMAT'ta hedefin kapsanması fazla, İYİ DEĞİL,
IMRT'de doz düşüşü daha keskin, kritikler daha düşük**

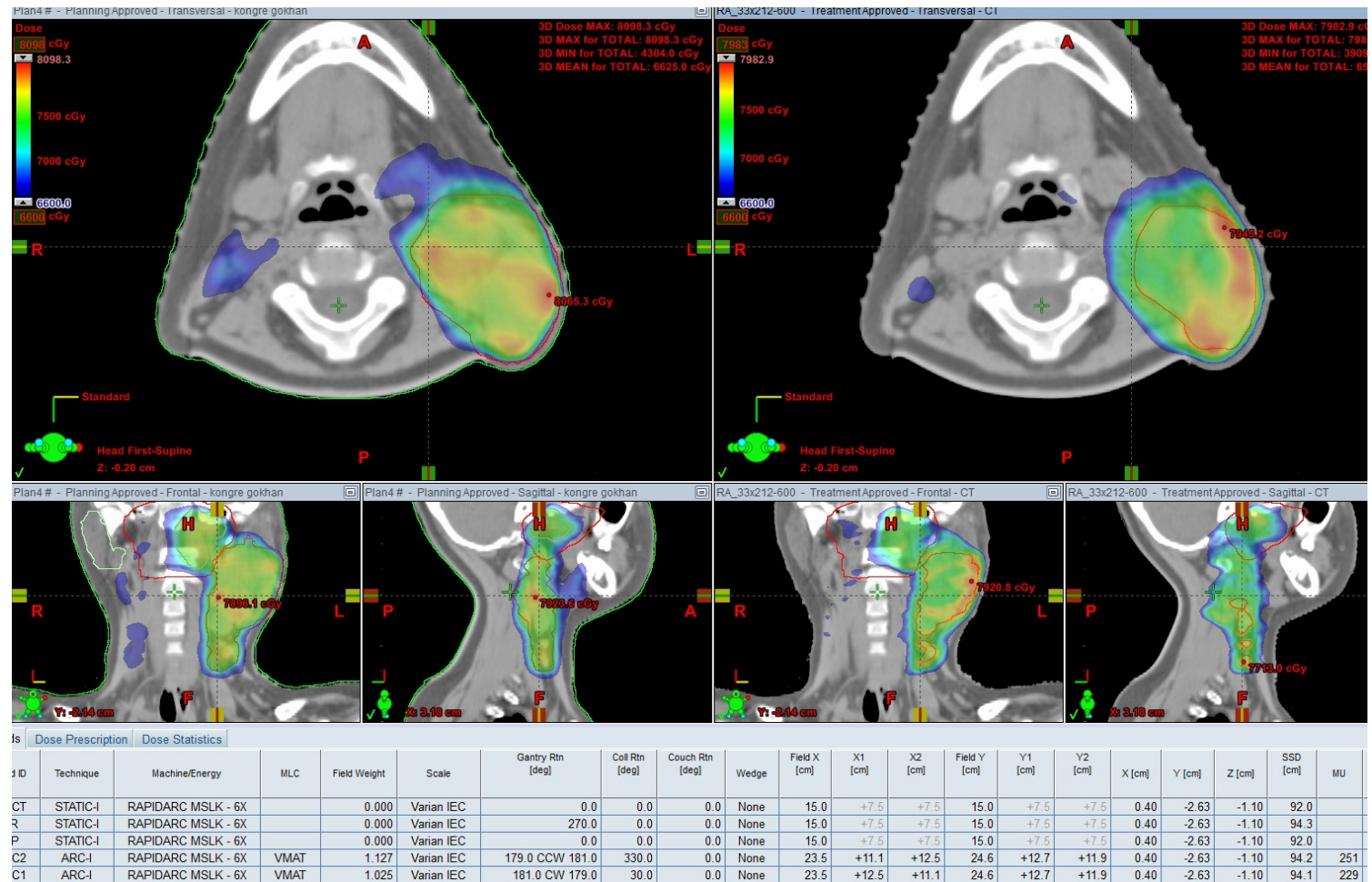
IMRT vs VMAT 50Gy



IMRT vs VMAT 35Gy



IMRT vs VMAT



Ve mutlu son...

Kabul kriterleri ve yöntemler klinikler arasında farklılık gösterebilir

AMA

En iyi plan kalite kontrol ölçümü ile doğrulanmış Plandır!