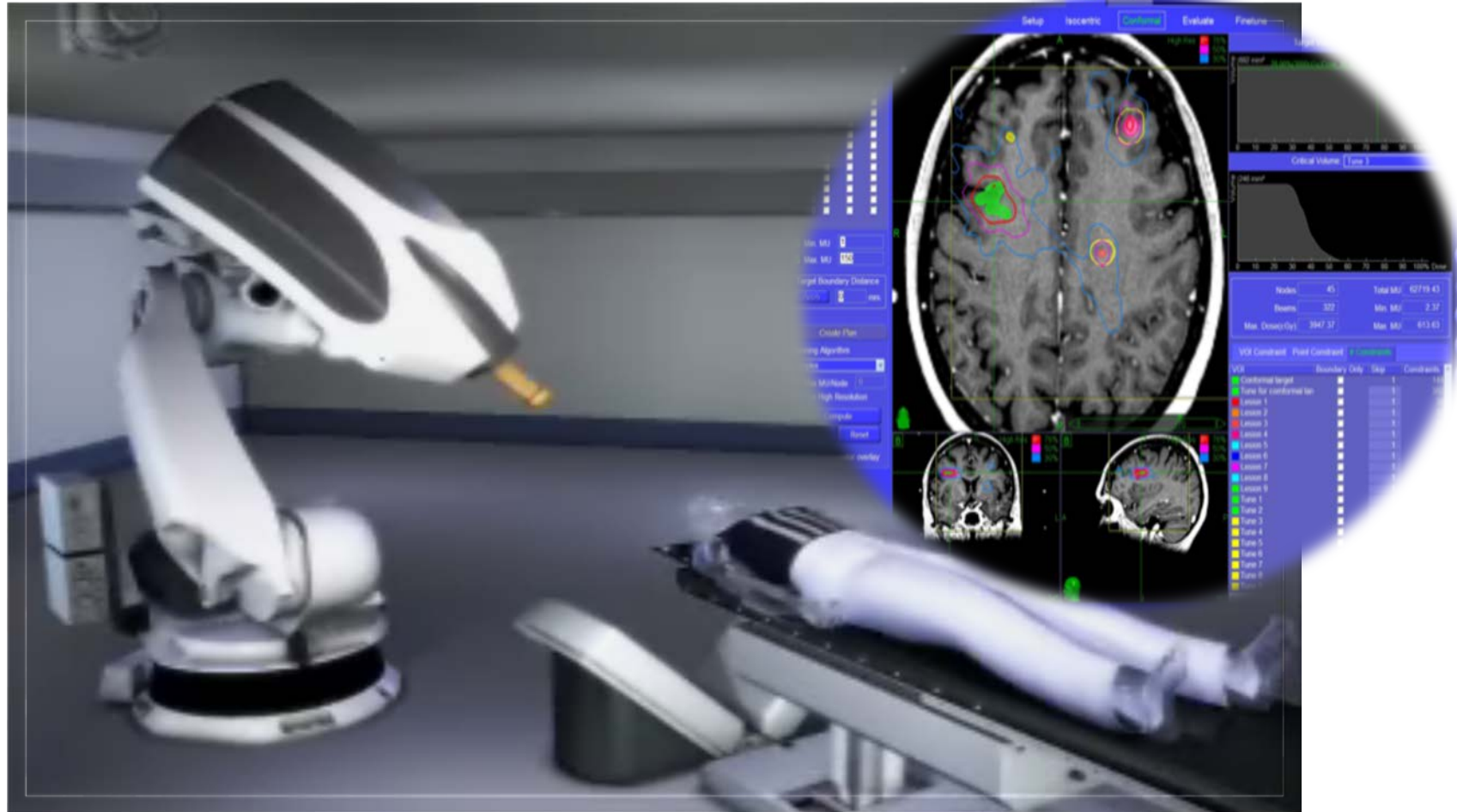


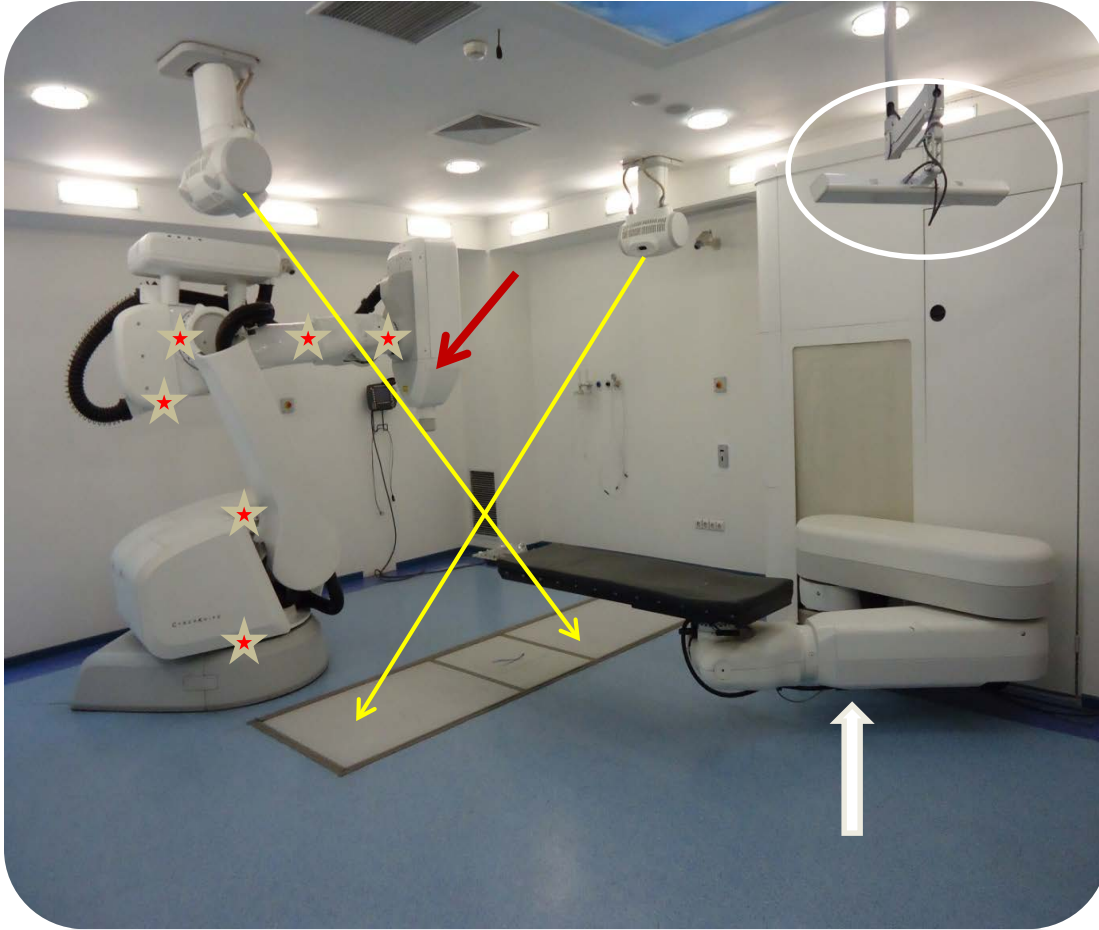
RADYO CERRAHİ (CYBERKNİFE)



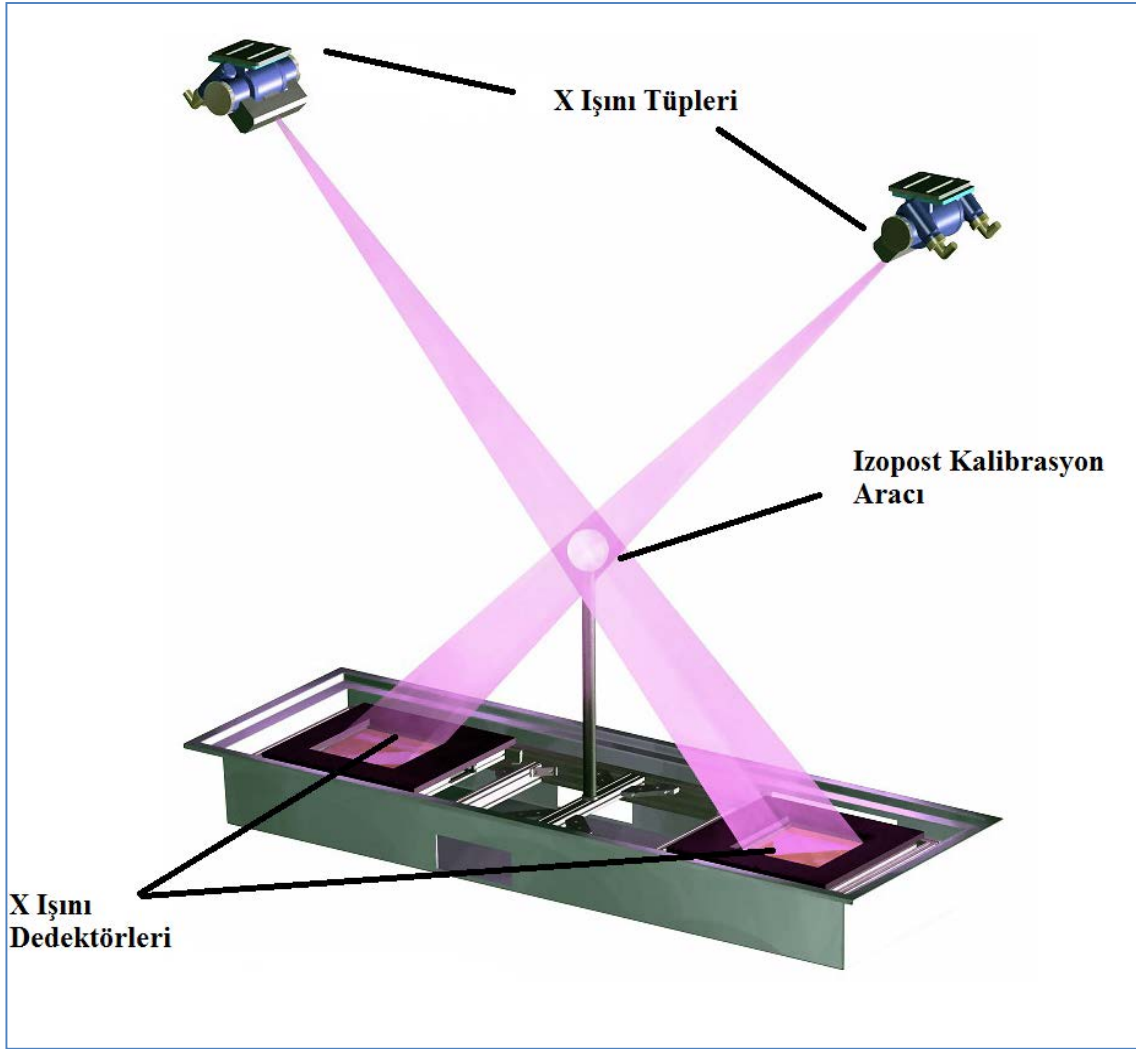
Yrd. Doç. Dr. Aydın ÇAKIR

İstanbul Üniversitesi Onkoloji Enstitüsü

CyberKnife Robotik Radyocerrahi Cihazı



- Bu sistemde robotik kola monte edilmiş kompakt bir 6-MV lineer hızlandırıcı kullanılır.
- Altı hareket serbestliği olan robotik kol, lineer hızlandırıcıya hasta etrafında konum değiştirme olanağı sağlar.
- Linak, 1200 huzme verebilir.
- Görüntüleme sistemi için, iki tane kilovoltaj X-ışını tüpü tavana monte edilmiştir.
- Altı hareket serbestliği olan tedavi masasına sahiptir.
- Synchrony ile solunum izleme mümkündür



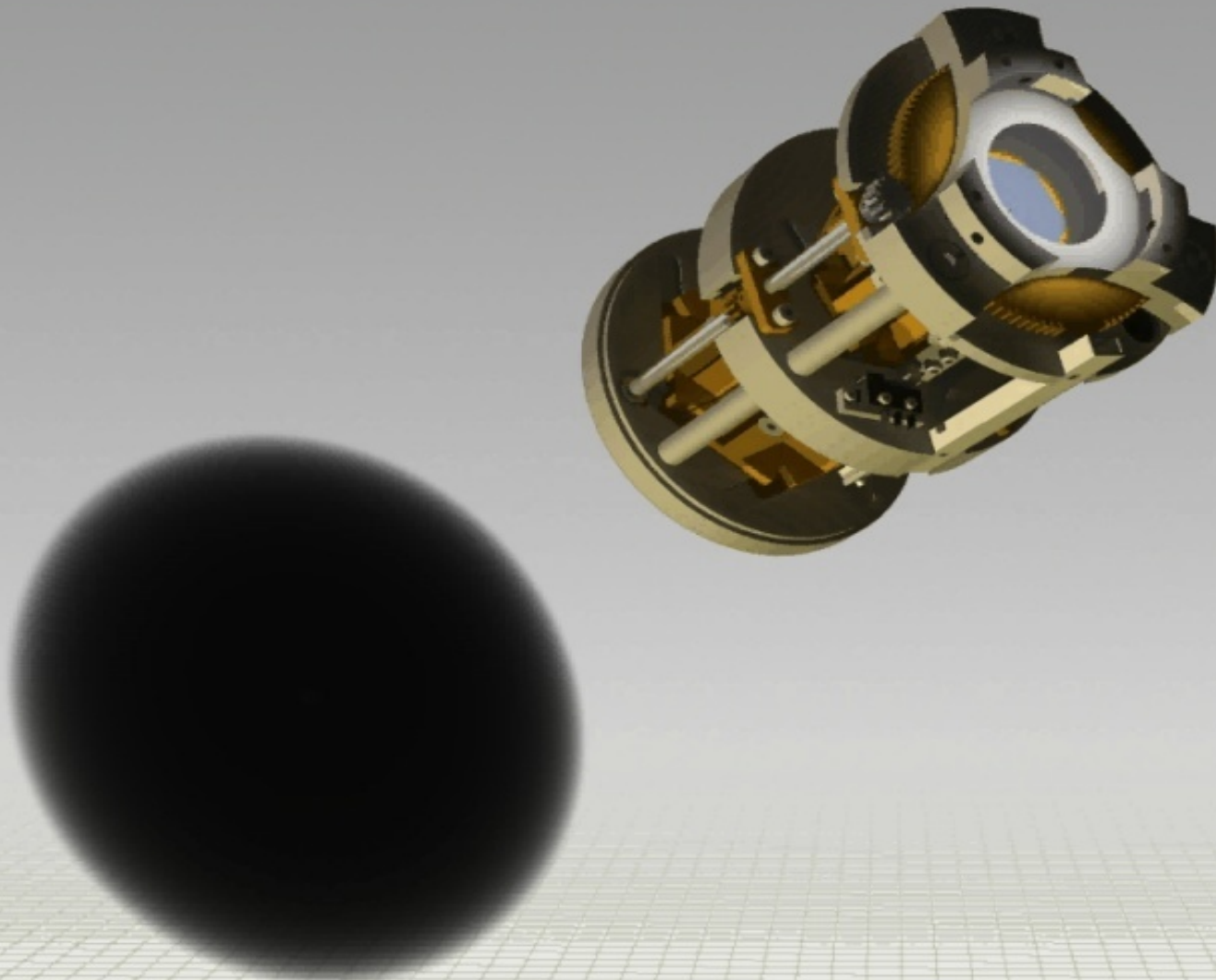
Işınlar dikeyden 45° açı ile zemine düz bir şekilde monte edilmiş olan $40 \times 40 \text{ cm}^2$ boyutlarındaki iki adet dedektör üzerine yansıtılır.

Teknik özellikler



5,7.5,10,12.5,15,20,25,30,35,40,50,60mm çaplı 12 adet standart kolimatör

IRIS kolimatör



CyberKnife[®] Robotik SRS/SBRT

X-ışını vermek için robotik sistemi kullanır

Vücutta herhangi bir tümörü tedavi etmek için kullanılır

Yüksek doğruluğa sahip (<1mm)

Tekrarlanabilir hassasiyet (0.12 mm)

1200 non-coplaner huzme

Non-izosantrik tedavi

Gelişmiş görüntü kılavuzluğu

Görüntü kılavuzlu hasta set-up'ı

Çeşitli izleme yöntemleri

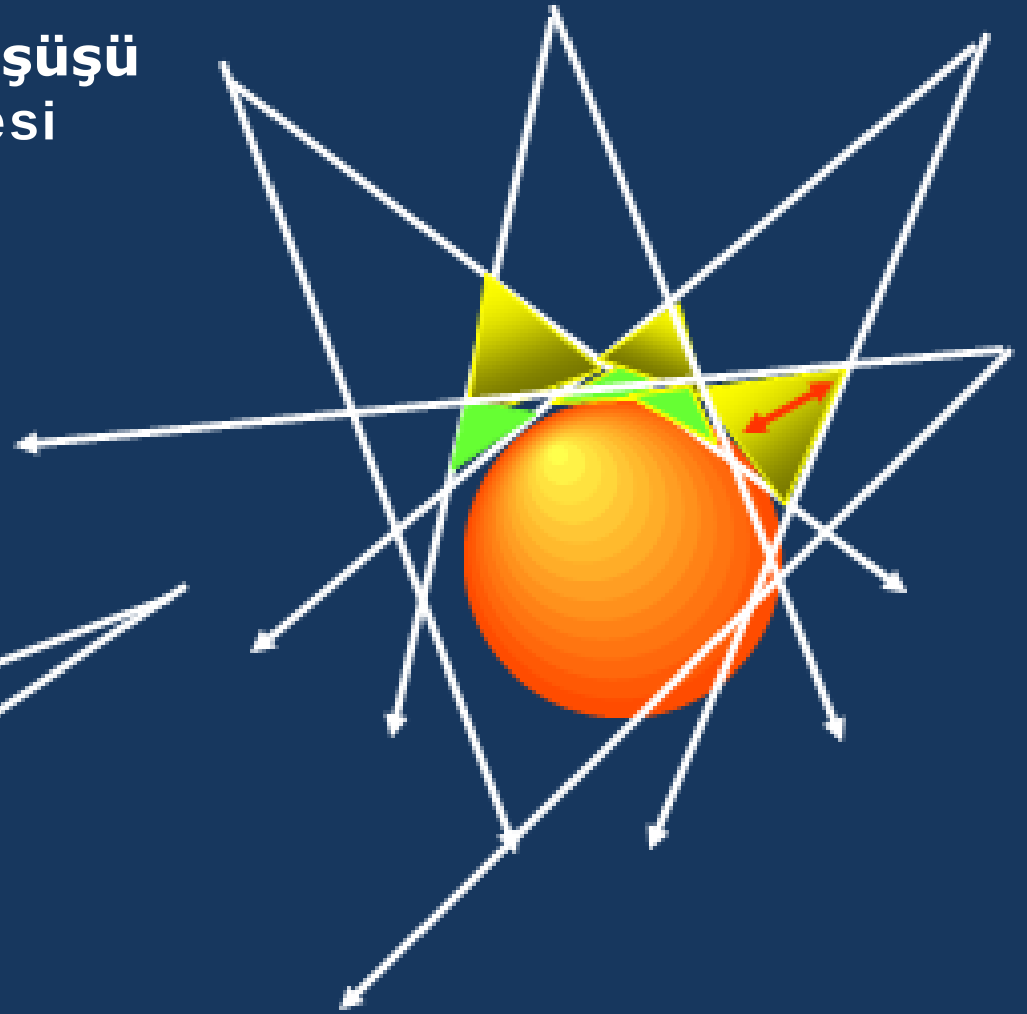
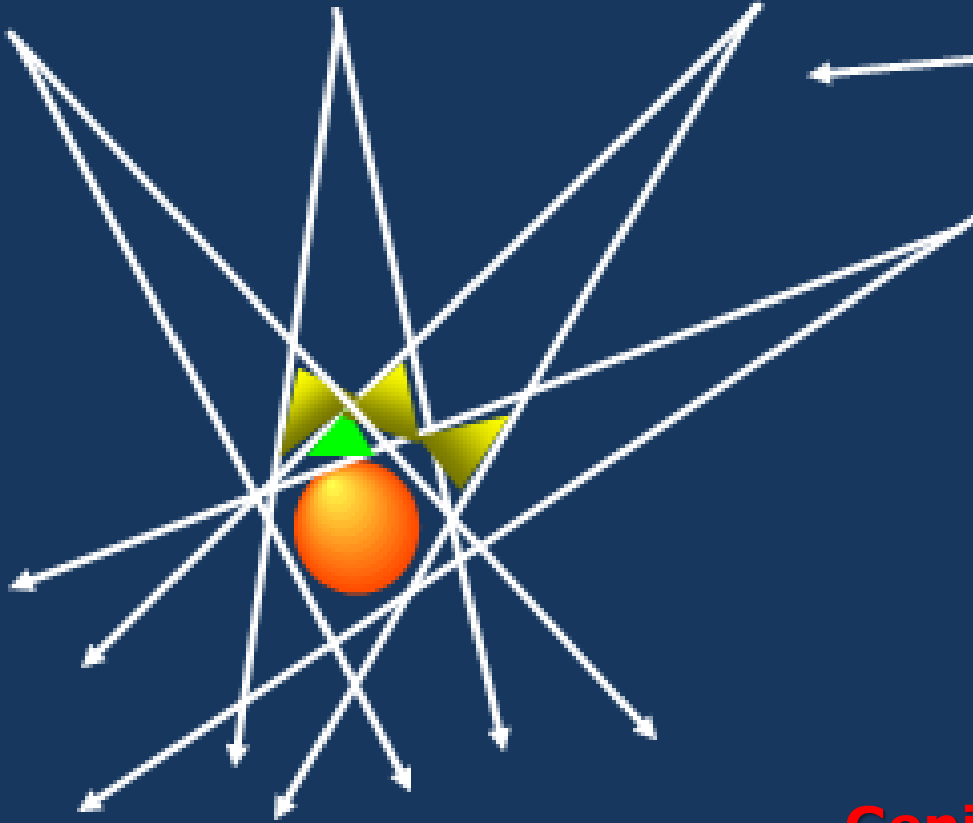
Tüm tedavi boyunca hareket otomatik olarak tespit edilir ve düzeltilir

İnvaziv değildir, çerçeve (frame) kullanılmaz



Küçük target volüm

Target dışında hızlı doz düşüşü
ve tümörde doz konformitesi



Geniş target volüm

İyi doz konformitesi, target
dışında daha yavaş doz düşüşü

Cyberknife izleme metotları

6D SKULL

SYNCHRONY
(Respiratory Motion
Tracking)

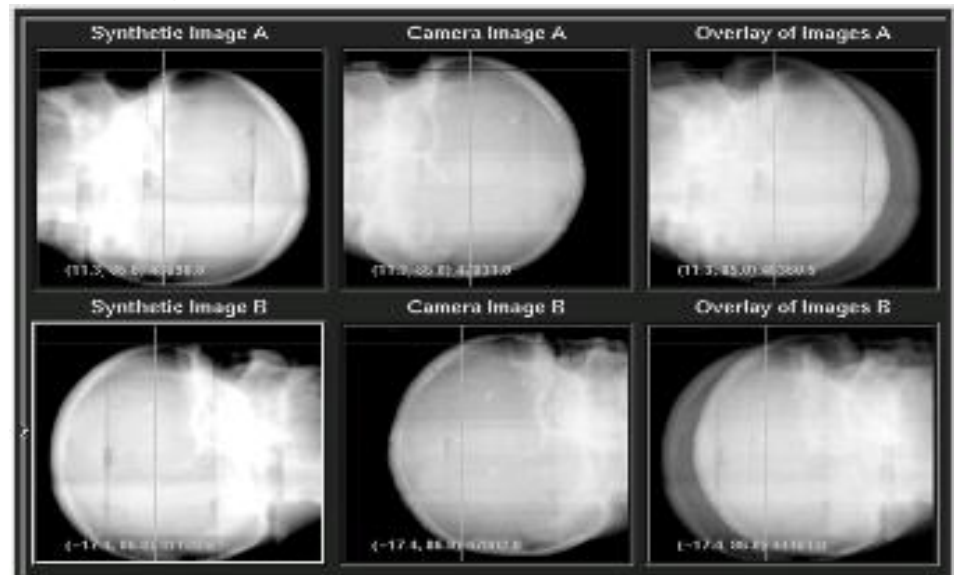
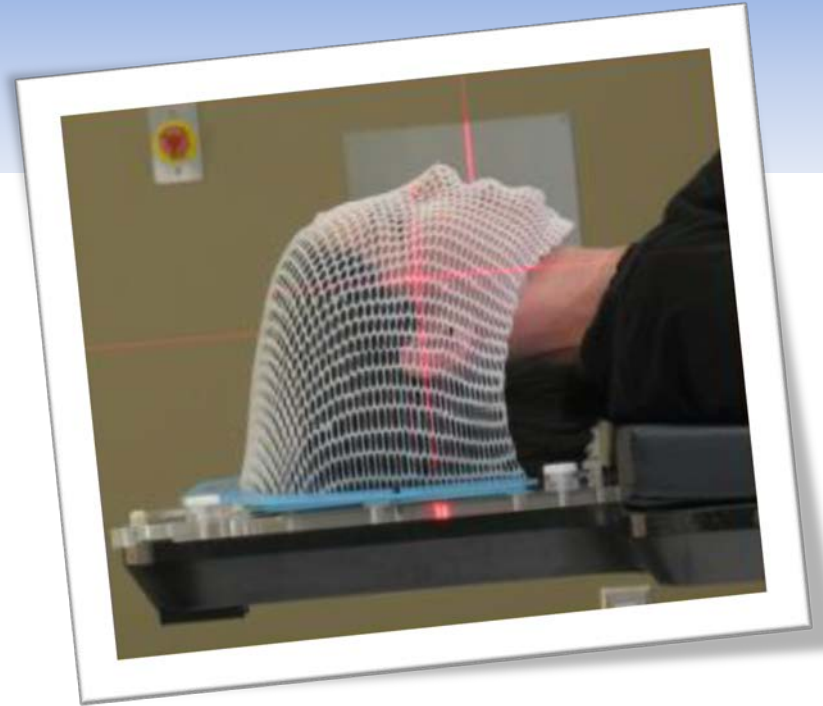
**X SIGHT
SPINE**

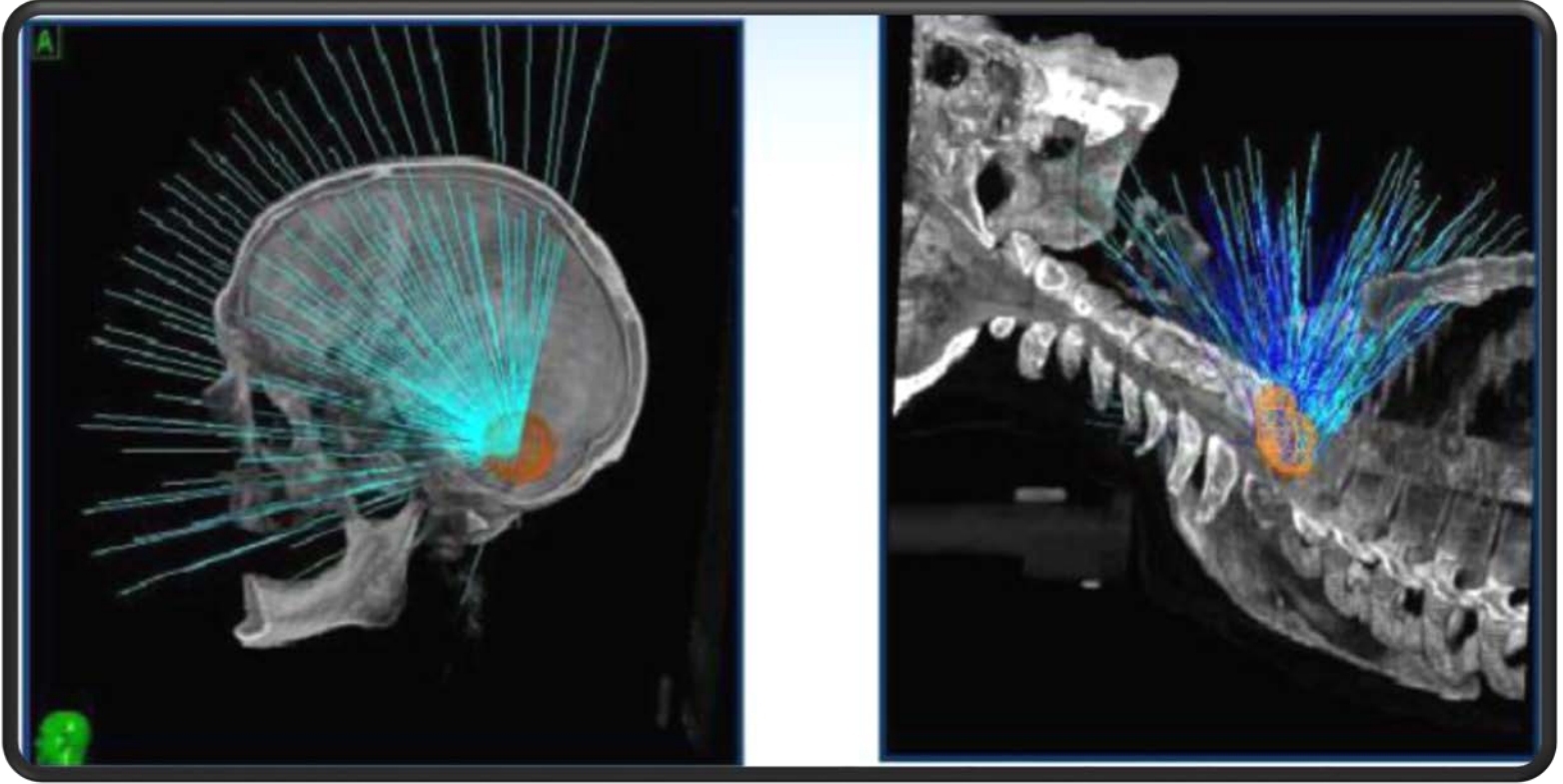
**X SIGHT
LUNG**

FIDUCIAL

6D Skull izleme

- Kafatası izleme algoritması
- Kafatası kemik yapısı kullanılır.
- Invaziv bir uygulama değildir
- Termoplastik maske
- Intrakranyum olguları + C2-C3





Görüntü rehberliğiyle beraber robotik teknolojiyi kullanan tek radyocerrahi sistemi olan CyberKnife, milimetrenin altında bir hassasiyetle intrakranyal ve extrakranyal hedeflere, invaziv bir sabitleme aracı olmaksızın uygulanır.

Dose Calculation

Algorithm

Ray-Tracing

Resolution

High

Uncertainty %

0

Calculate

Prescription

Prescription

Reference Point

☒ Use max dose point

Dose (cGy)

3253.01

Point

Go to >>

-15.11,121.75,-317.00

Set to Cross-hair Point

Save Plan

Save Plan

Standard

Display

Patient

NADIRE PAMUK

20127402CK2

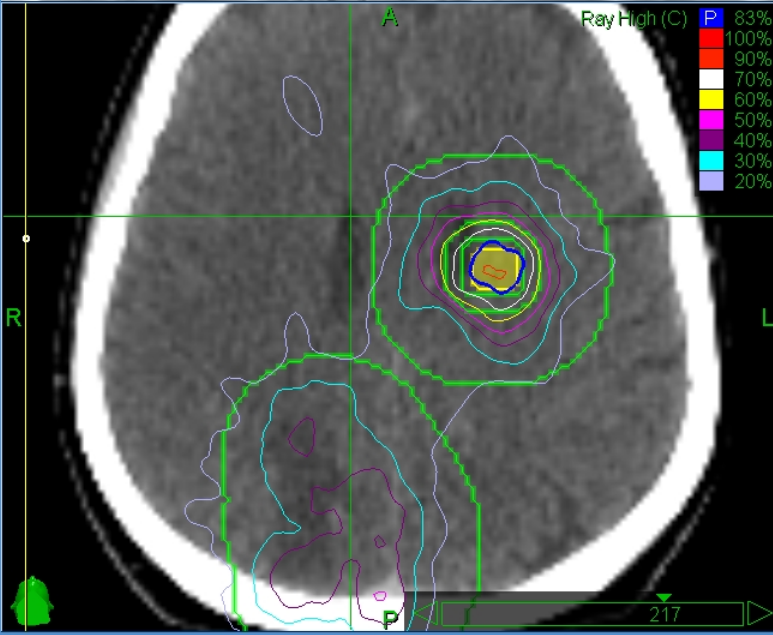
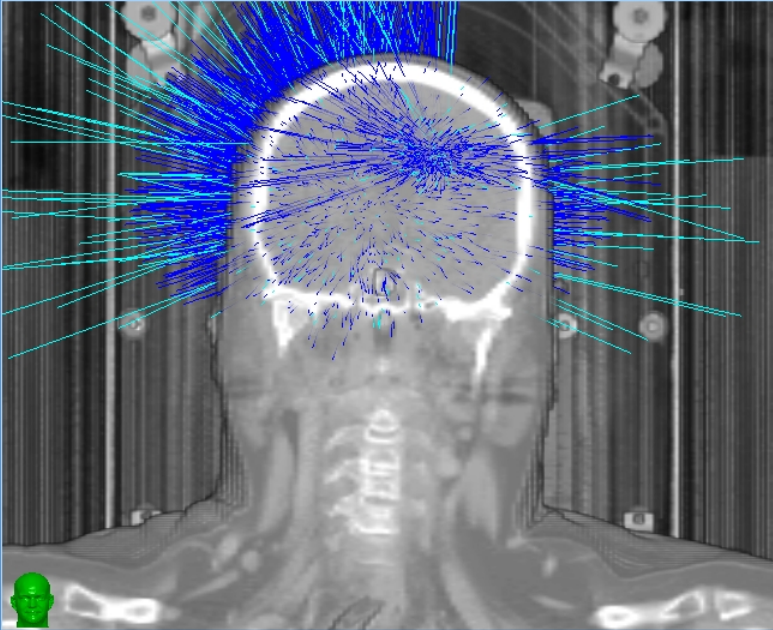
Plan

PLAN2

2013-11-19 16:47:06

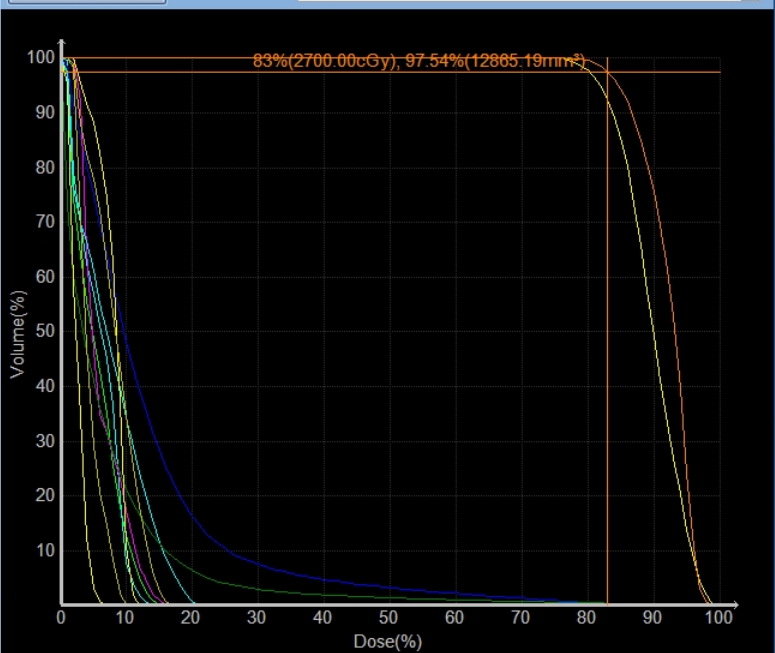
Rx

83%, 2700.00 cGy



DVH Properties

Active DVH: PTV1



Nodes	116	Total MU	43269.29
Beams	281	Min MU	24.93
Max Dose (cGy)	3253.01	Max MU	249.64

Dose Statistics Table							
VOI	Min (cGy)	Mean (cGy)	Max (cGy)	CI	nCI	HI	Coverage
PTV1	2473.53	2999.15	3253.01	1.33	1.37	1.20	97.54%
PTV2	2483.20	2921.16	3227.73	13.70	14.81	1.20	92.46%
GTV 1	2768.44	3067.79	3253.01	2.28	2.28	1.20	100.00%
GTV 2	2702.16	3022.64	3227.73	31.77	31.77	1.20	100.00%
RLENS	80.38	258.47	376.53	n/a	n/a	n/a	n/a
LLENS	31.22	82.42	206.26	n/a	n/a	n/a	n/a
Optic Chiasm	80.68	199.92	530.32	n/a	n/a	n/a	n/a
Brain Stem	28.40	249.33	683.13	n/a	n/a	n/a	n/a
ROPTIKSNR	51.93	143.45	309.08	n/a	n/a	n/a	n/a
LOPTIKSNR	59.02	269.21	542.05	n/a	n/a	n/a	n/a
Left Eye	25.59	175.50	499.50	n/a	n/a	n/a	n/a
Right Eye	30.18	189.78	442.97	n/a	n/a	n/a	n/a
BEYIN	22.78	427.07	3227.73	n/a	n/a	n/a	n/a

Collimators

Script

⏏📁✖

MU Limits

Auto-shells

VOI Limits

Steps

VOI, Objective

1PTV1, OMI

2PTV2, OMI

3PTV1, OCO

4PTV2, OCO

5PTV1, OHI

6PTV2, OHI

7[PTV1] Shell 1, OCI

8[PTV2] Shell 1, OCI

9[PTV1] Shell 2, OCI

10[PTV2] Shell 2, OCI

⏪⏩⏴⏵

☐ Relaxed Convergence

Beam Reduction

Dose Calculation

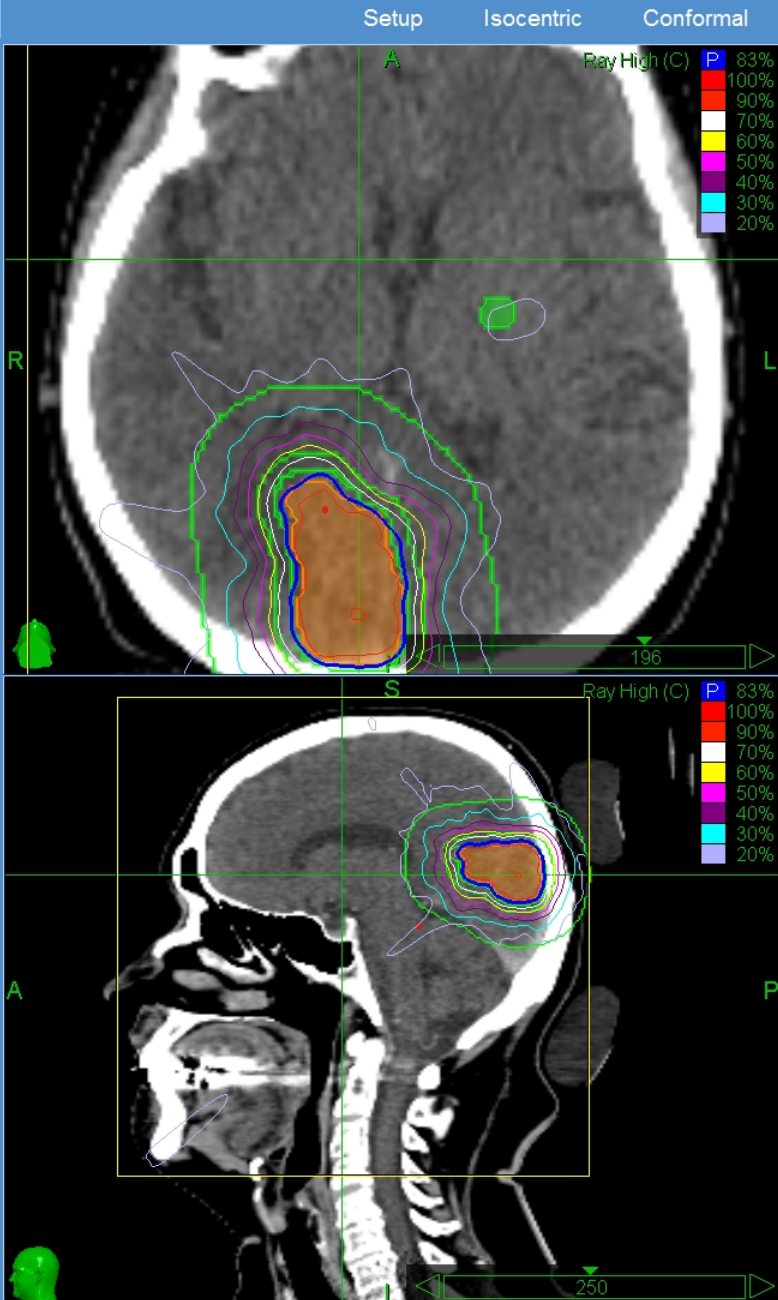
AlgorithmRay-Tracing

ResolutionHigh

Uncertainty %0

Prescription

StandardDisplay



DVH PropertiesActive DVH: PTV1

Nodes116Total MU43269.29

Beams281Min MU24.93

Max Dose (cGy)3253.01Max MU249.64

Dose Statistics Table

VOI	Min (cGy)	Mean (cGy)	Max (cGy)	CI	nCI	HI	Coverage
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GTV 1	2768.44	3067.79	3253.01	2.28	2.28	1.20	100.00%
GTV 2	2702.16	3022.64	3227.73	31.77	31.77	1.20	100.00%
RLENS	80.38	258.47	376.53	n/a	n/a	n/a	n/a
LLENS	31.22	82.42	206.26	n/a	n/a	n/a	n/a
Optic Chiasm	80.68	199.92	530.32	n/a	n/a	n/a	n/a
Brain Stem	28.40	249.33	683.13	n/a	n/a	n/a	n/a
ROPTIKSNR	51.93	143.45	309.08	n/a	n/a	n/a	n/a
LOPTIKSNR	59.02	269.21	542.05	n/a	n/a	n/a	n/a
Left Eye	25.59	175.50	499.50	n/a	n/a	n/a	n/a
Right Eye	30.18	189.78	442.97	n/a	n/a	n/a	n/a
BEYIN	22.78	427.07	3227.73	n/a	n/a	n/a	n/a
[PTV1] Shell 1	2112.26	2591.69	2931.45	n/a	n/a	n/a	n/a
[PTV1] Shell 2	1447.99	2033.82	2530.57	n/a	n/a	n/a	n/a
[PTV2] Shell 1	2208.53	2834.61	3020.00	n/a	n/a	n/a	n/a

Patient
NADIRE PAMUK
20127402CK2

Plan
PLAN2
2013-11-19 16:47:06

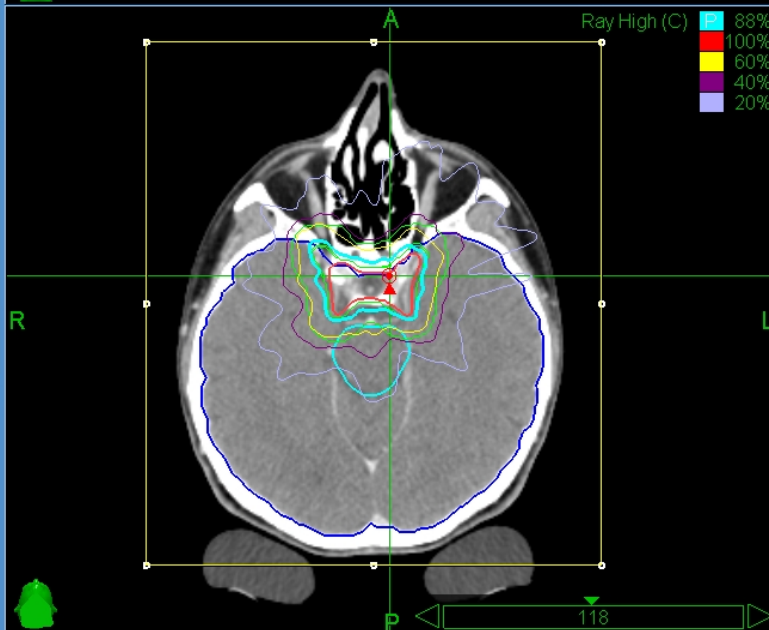
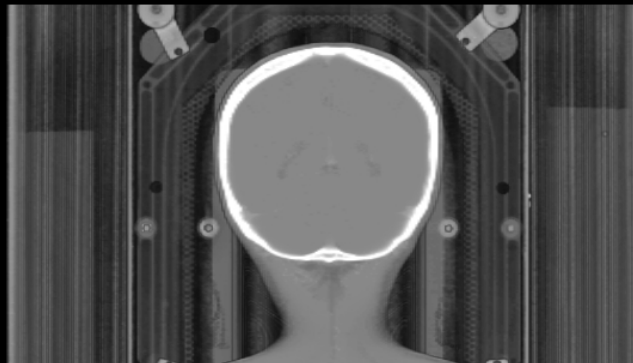
Rx
83%, 2700.00 cGy

☐ Show Isocenters

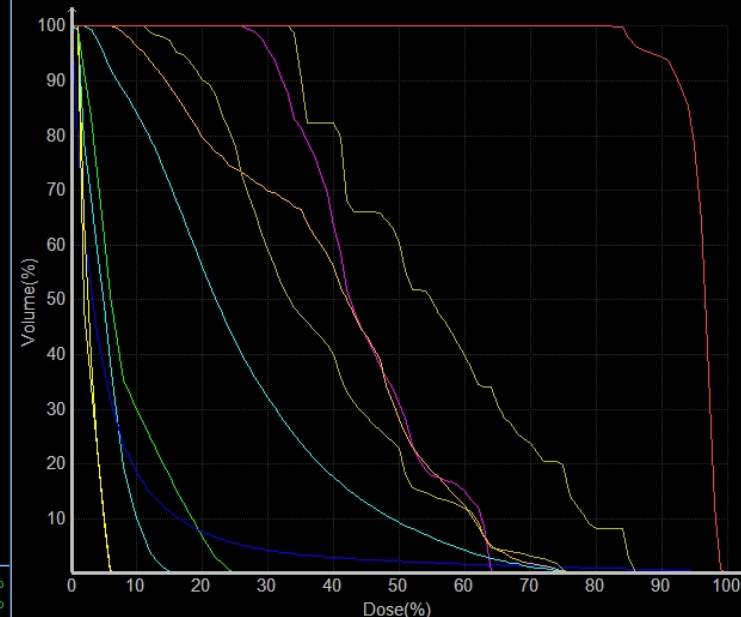
☒ Show Beam on 3D

Show 3D VOIs

Show	VOI
☐	GTV
☐	Left Eye
☐	Right Eye
☐	BEYIN
☐	Optic Chiasm
☐	Brain Stem
☐	stalk
☐	RLENS
☐	LLENS
☐	ROPTIKSNR
☐	LOPTIKSNR



DVH Properties Active DVH: GTV



Nodes	81	Total MU	26176.30
Beams	135	Min MU	46.35
Max Dose (cGy)	3536.10	Max MU	444.66

Dose Statistics Table

VOI	Min (cGy)	Mean (cGy)	Max (cGy)	CI	nCI	HI	Coverage
GTV	2914.51	3388.00	3536.10	2.06	2.16	1.14	95.22%
Left Eye	31.08	293.08	937.35	n/a	n/a	n/a	n/a
Right Eye	32.21	187.16	597.58	n/a	n/a	n/a	n/a
BEYIN	13.87	259.95	3536.10	n/a	n/a	n/a	n/a
Optic Chiasm	927.31	1588.14	2267.34	n/a	n/a	n/a	n/a
Brain Stem	72.52	902.05	3017.24	n/a	n/a	n/a	n/a
stalk	1196.94	1978.73	3046.38	n/a	n/a	n/a	n/a
RLENS	38.69	91.44	203.42	n/a	n/a	n/a	n/a
LLENS	41.06	102.37	213.56	n/a	n/a	n/a	n/a
ROPTIKSNR	219.77	1397.01	2670.57	n/a	n/a	n/a	n/a
LOPTIKSNR	393.78	1316.17	2693.12	n/a	n/a	n/a	n/a
[GTV] Shell 1	2102.77	3083.68	3461.90	n/a	n/a	n/a	n/a
[GTV] Shell 2	249.18	1394.05	2535.24	n/a	n/a	n/a	n/a

Patient
EYLEM KILIC
20135415CK

Plan
plan1h
2013-11-19 04:43:54

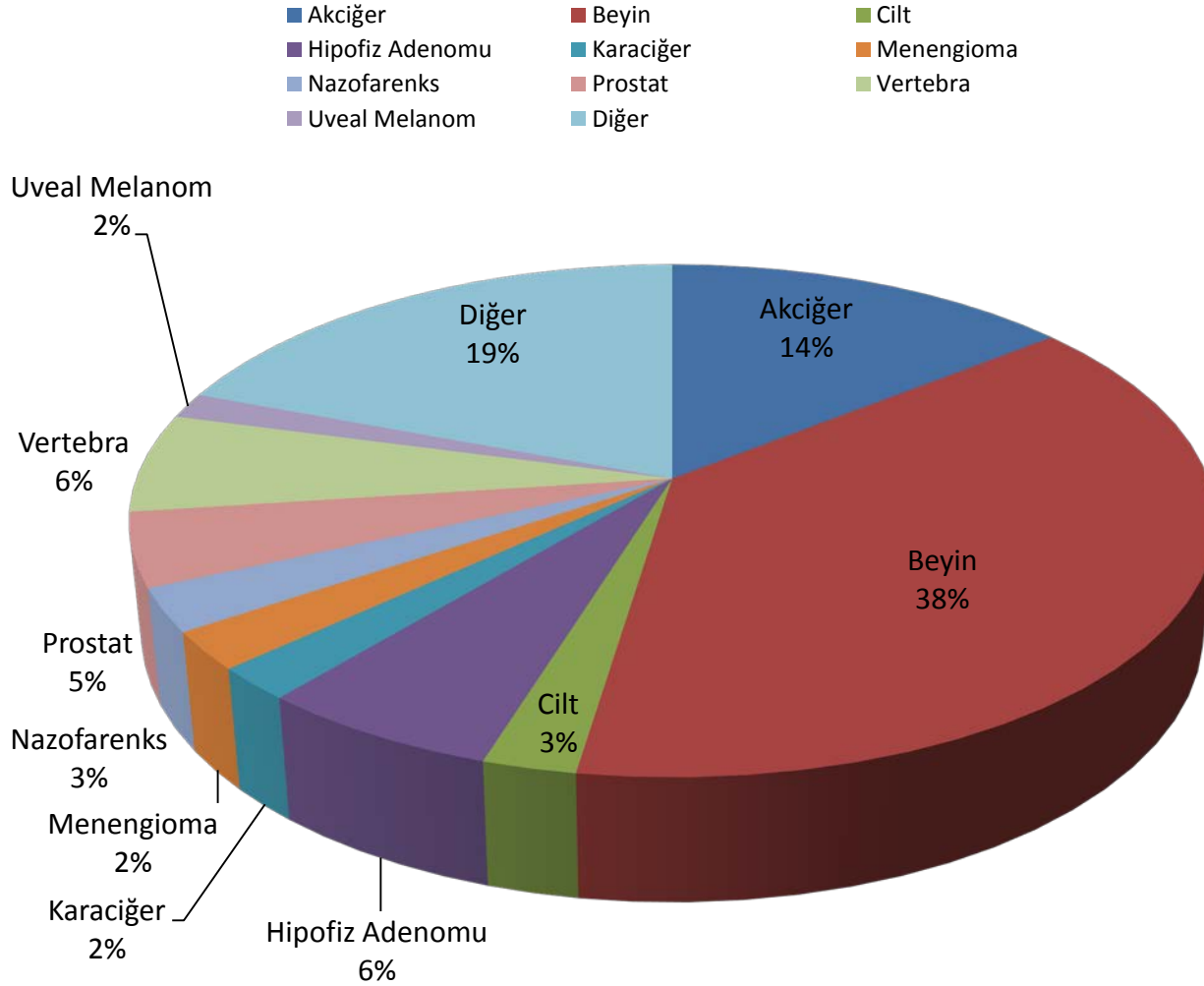
Rx
88%, 3111.76 cGy

Cyberknife tedavileri

- Metastases (+/- XRT)
- Meningioma
- Schwannoma/Neurofibroma
- Hemangioma
- Chordoma
- Lymphoma/ Multiple myeloma
- ? Astrocytoma
- ? Ependymoma
- ? AVM

- Akciğer
- Karaciğer
- Sürrenal lezyonlar
- Prostat
- Yumuşak doku tm.
- Basal cell. tm.

İ.Ü.Onkoloji Enst. Cyberknife Hasta Dağılımı





Abi ne iş olursa
yaparım...

