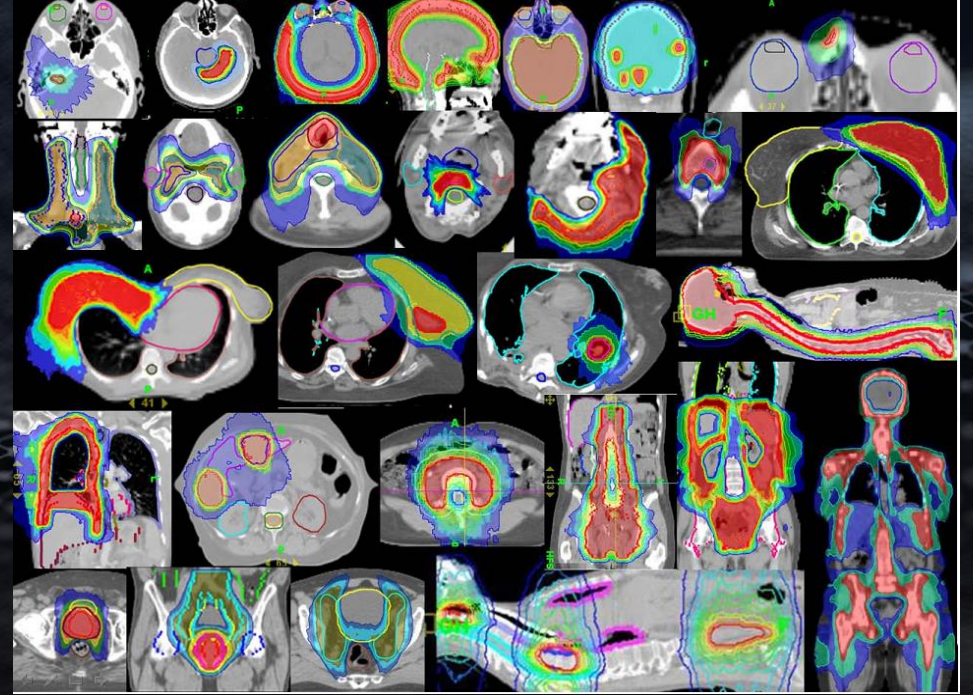
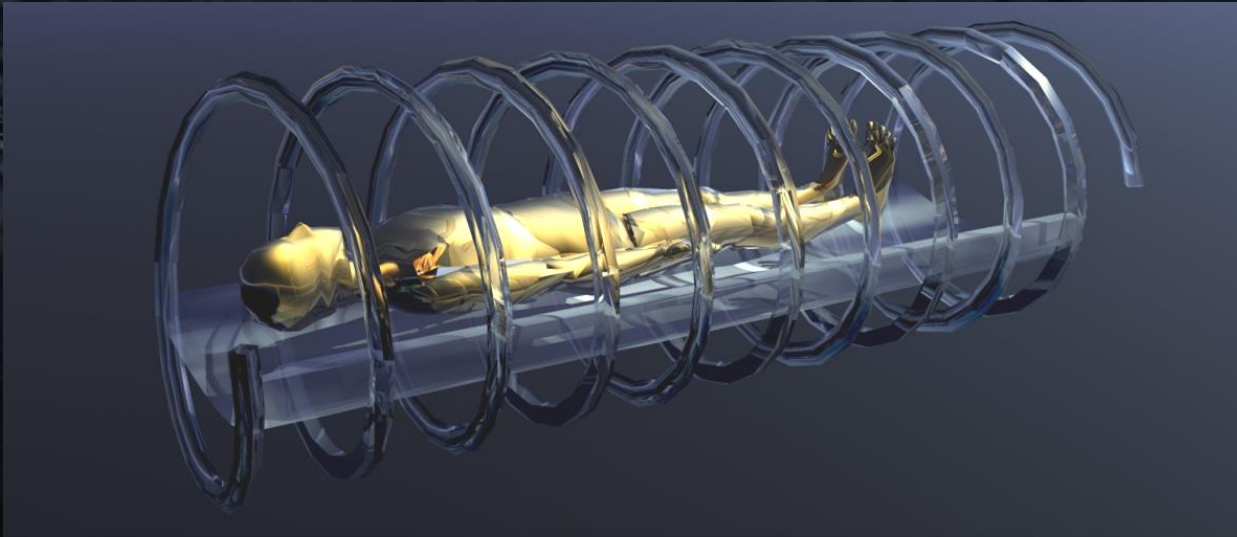


TomoTherapy ve Radixact Planlamada Genel Kavramlar

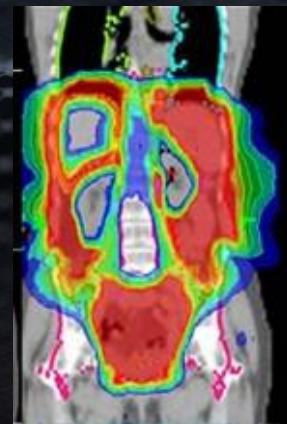
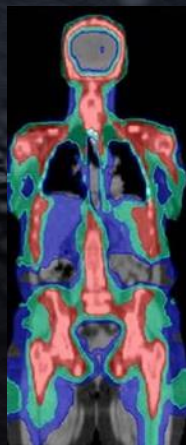


Tedavi Konsepti?

- 160 cm Treatment Field on Longitudinal Direction



- 160 cm Treatment Field on Longitunal Direction



What is most important component of LINACs ?

- MLC

Which feature make MLC better for dose shaping?

- Faster MLC is better
- Thinner the MLC is better

So How Fast is Radixact MLC compare to conventinonal MLC

2 times

5 times

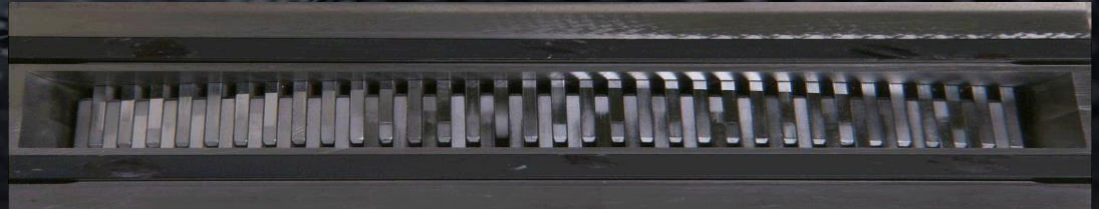
20 times

50 times

100 times

100 Times Faster MLC

- 100 times faster MLC
- 11 ms opening and closing time
- All MLC 6mm thickness
- Binary mode
- Pneumatic design
- Lowest leaf leakage 0,3% Mean



Tedavi Alanı Belirleme

Seenekler

- 1 cm
 - SRS ve Y yönünde uzun olmayan tümörlerde <5 cm
- 2.5 cm
 - Normal tümör boyutlarında 5-20 cm aralığı
- 5 cm
 - Y yönünde Uzun tedavilerde(TBI,TBI, craniospinal) >15 cm



Tomotherapy Planması yaparken Fizikçinin belirlemesi gereken 3 parametre vardır

- **Tedavi Alan Genişliği**
- **Pitch**
- **Modulasyon Faktörü**

Pitch Faktörü

- Diğer Adı Helikal sarmal sıklığı
- Pitch Faktörü 0.1 ile 0.5 Arasındadır
- Formül olarak $\text{Pitch} = (\text{Masa hareketi/bir rotasyon}) / \text{Alan genişliği}$
- Aslında Pitch'i arc gibi düşünebiliriz
 - Pitch 1 ise 1 tam Arc
 - Pitch 0,5 ise 2 tam Arc
 - Pitch 0,25 ise 4 tam Arc

Pitch Faktörü



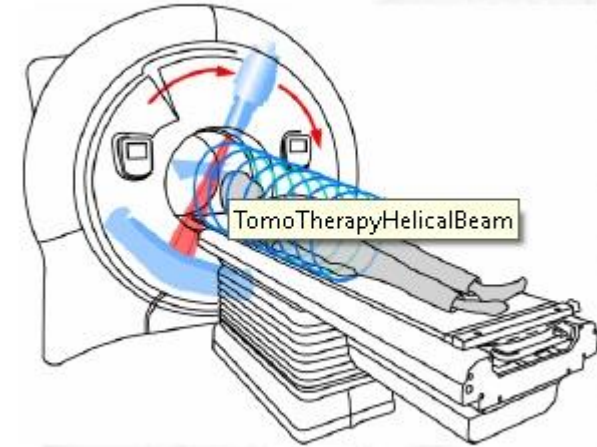
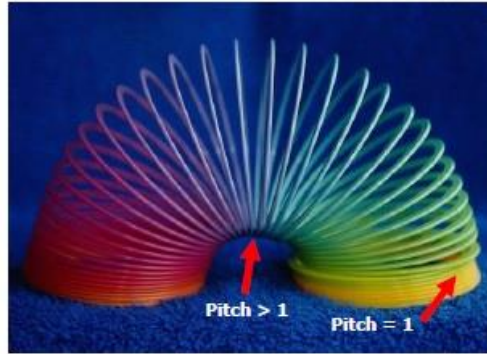
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Treatment Geometry Overview:

Pitch

$$\text{pitch} = \frac{d_{\text{couch}} / \text{rotation}}{\text{field width}}$$

- Pitch < 1: Overlap from one rotation to the next (more tightly wound helix).
- Pitch = 1: Couch travels one field width per rotation. FWHM of adjacent rotations line up exactly at isocenter.
- Pitch > 1: Missing some portions of the patient from some beam angles.

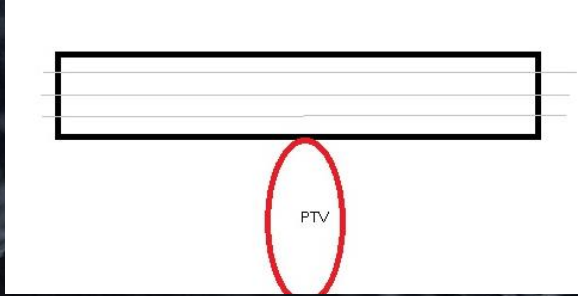


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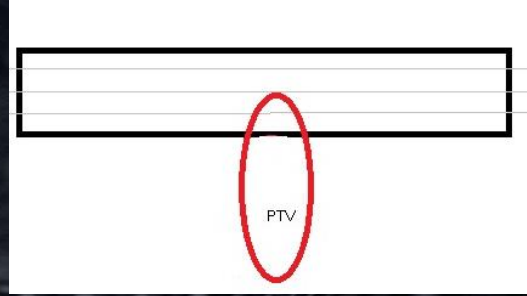
Pitch Faktörü

Örnek : Pitch=0,5

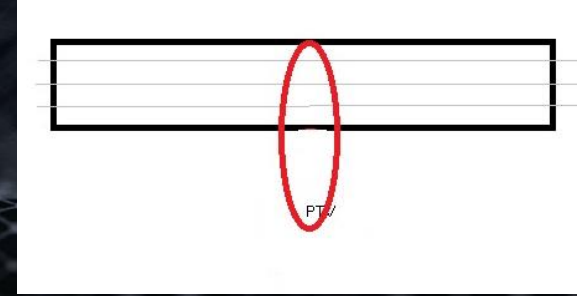
Başlangıç



1 tur sonra



2 tur sonra



Pitch Effects: Helical Junctioning

Medical Physics, Vol. 32, No. 5, May 2005

Kissick *et al.*: The helical tomotherapy thread effect

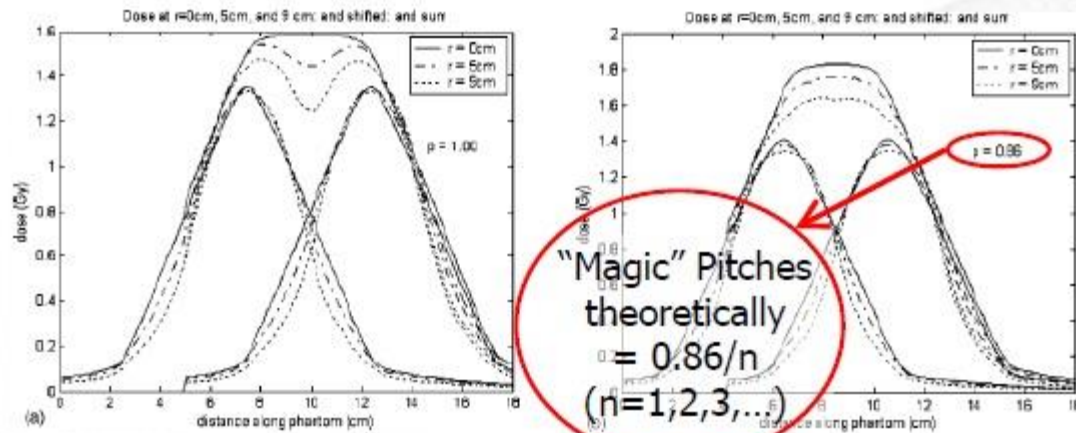
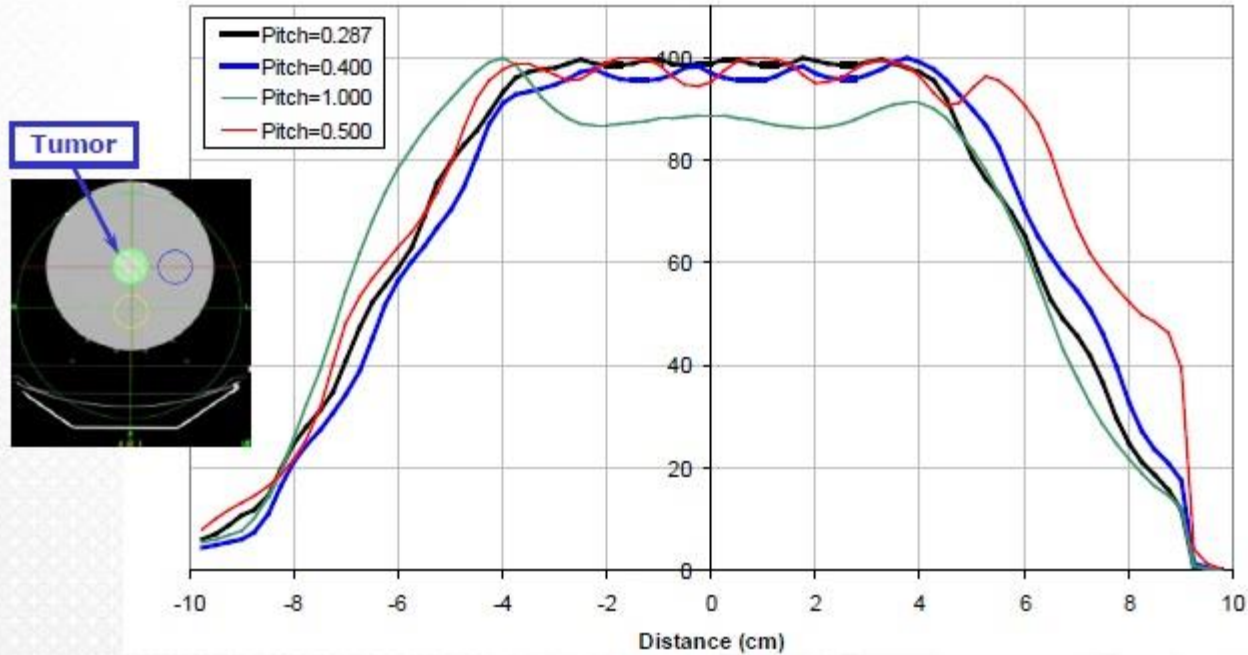


FIG. 6. Single rotation dose profile at radii=0, 5, 9 cm out from the isocenter, then shifted by width*pitch and added to the unshifted profiles. The shift and add is done with the full three-dimension dose profile. Notice the consequence of the non-triangular off-axis dose profiles shape and long axial dose profiles tails in creating the best junctioning at pitch of 0.86 (b) rather than at the expected pitch of 1.0 (a) or at pitch of 0.70 (c).

Pitch Effects: Superior-Inferior Dose Profiles



Longitudinal dose profiles for commissioning treatment plan.

5.0-cm beam; tumor on the patient axis, but 7 cm above gantry isocenter.

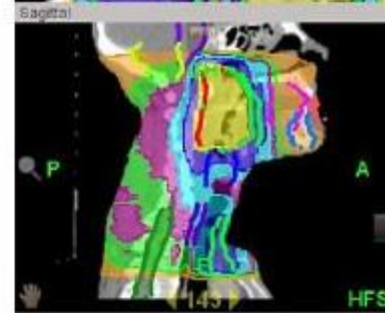
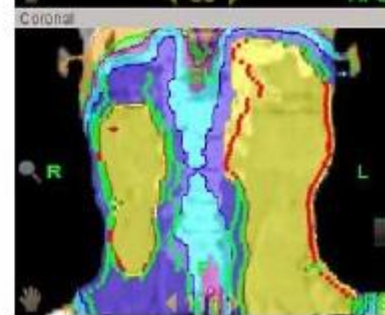
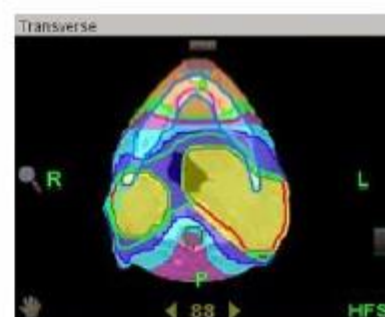
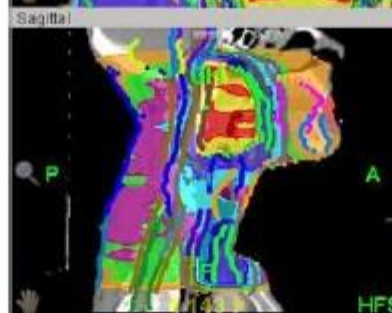
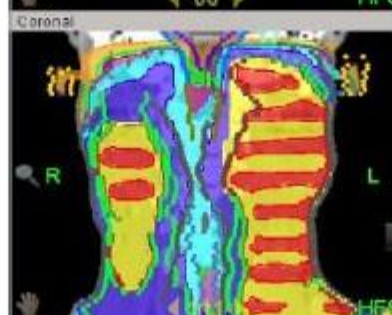
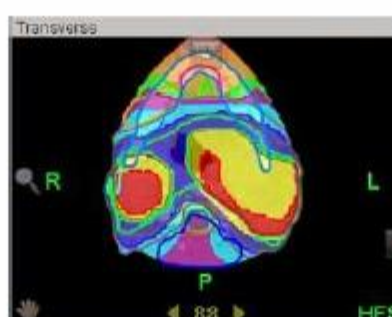
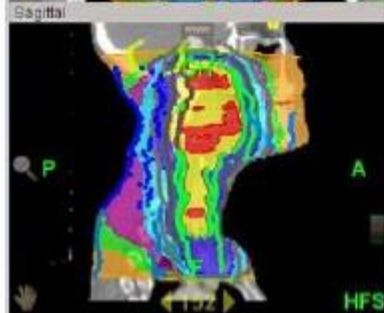
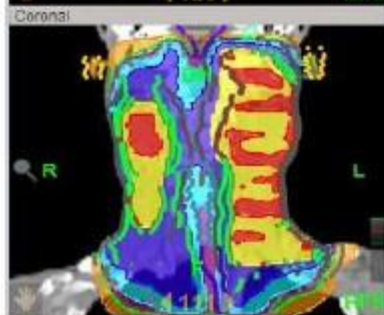
Pitch Faktörü

TABLE II. An example of optimal pitches from Fig. 9. For each of the four off-axis, largest five optimal pitches for four different jaw profiles: square (square profile), (real profile 1.05 cm), and 1.05 cm

1-3Gy per fraction

ir columns of the
(m), and 1.05 cm

Off axis: 5 cm				Off axis: 10 cm				Off axis: 15 cm				Off axis: 20 cm			
Square	5.02 cm	2.5 cm	1.05 cm	Square	5.02 cm	2.5 cm	1.05 cm	Square	5.02 cm	2.5 cm	1.05 cm	Square	5.02 cm	2.5 cm	1.05 cm
0.857	0.8600	0.867	0.845	0.8340	0.8330	0.842	0.826	0.7940	0.7980	0.811	0.792	0.7400	0.7540	0.771	0.748
0.438	0.4440	0.446	—	0.4230	0.4330	0.436	—	0.4060	0.4180	0.420	—	0.3870	0.3970	0.397	—
0.297	0.3030	0.303	—	0.2900	0.2970	0.295	—	0.2790	0.2850	0.282	—	0.2610	0.2670	0.264	—
0.227	0.2310	0.233	—	0.2210	0.2250	0.225	—	0.2110	0.2150	0.212	—	0.1960	0.2000	0.197	—
0.184	0.1870	—	—	0.1790	0.1820	—	—	0.1690	0.1720	—	—	0.1560	0.1590	—	—



Modulasyon Faktörü

- 1-5 arasında bir değerdir.
- 5 en yüksek modulasyondur ,1 ise en düşük modulasyondur
- Modulasyon artıkcı Gantri daha yavaş döner
 - Yavaş dönünce bir projeksiyon açısında daha uzun kalır
 - Böylece daha yüksek leaf open zaman modulasyonu yapar
 - Donuç MF artınca Dozlar daha da iyi olur fakat süre de uzar

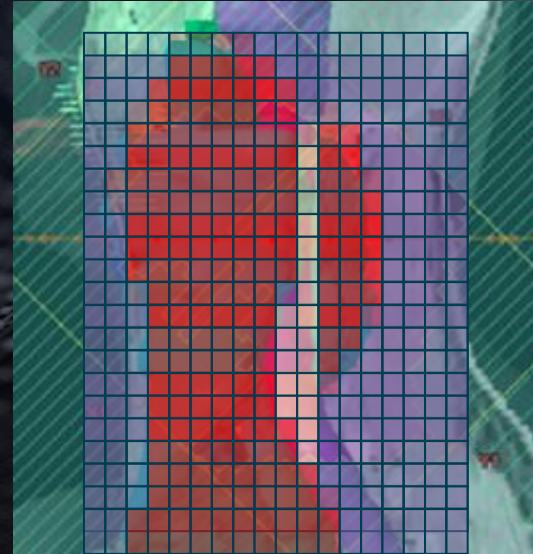
Genelde MF 2 ile başlanır dozlar beğenilmezse artırılır.

IMAT



One un-modulated
beam “segment” at
each sampling angle

Radixact



Many modulated beam
projections at each delivery
beam angle



Treatment Geometry Overview: Projections, Beamlets, and Rays

- **51 projections** (beam delivery angles) per rotation, spanning 7.06° ($=360^\circ/51$) each.
 - The Treatment Planning System (TPS) assumes that radiation is delivered from 51 discrete angles centered on each projection.
 - Actual gantry rotation is continuous.
- **64 beamlets** per projection (one for each MLC leaf).
 - A single gantry rotation has $51 \times 64 = 3,264$ beamlets.
 - A treatment with 30 rotations would have 97,920 beamlets.
 - The MLC is binary; each leaf is either fully open or fully closed.
 - However, individual leaf open times vary within a projection, allowing for many intensity levels across the radiation field.
- Each beamlet is divided into multiple **rays** for dose calculations; the TPS chooses the number to ensure at least one ray per voxel.



User Inputs: Modulation Factor (MF)

- The Modulation Factor limits the range of leaf-open times:

$$\text{Modulation Factor} = \left[\frac{\text{Max Open Time}}{\text{Avg Open Time}} \right]$$

- The user-defined MF sets an upper limit on the range of open times for “used” beamlets.
- Large MF’s create plans with a large fraction of small leaf-open times, which have larger uncertainties.

Optimize

Dose Calc Grid: Normal

Field Width: 2.5 cm - Ja...

Modulation Factor: 1.800

Pitch: 0.287

- Typical MF’s:
 - 1.8 for prostate
 - 2.4 for Head & Neck
- Increasing the MF:
 - Increases delivery time (generally linearly with MF)
 - Decreases efficiency
- Decreasing the MF may degrade dose conformity.

Teşekkürler