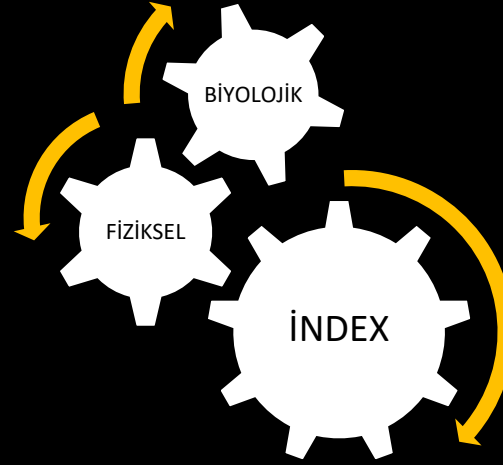


Radyocerrahi Tedavi Planlarının Kalitesinin Belirlenmesi : yeni bir indeks nPQI

Hasan UYSAL, Kaan OYSUL, Sait ŞİRİN
MEDICANA INTERNATIONAL ANKARA HASTANESİ

İNDEx



FİZİKSEL	
DOZİMETRİK İNDEx	GENEL PLAN İNDExİ
PITV	CQI
HI	COSI
CI	QF
TCI	COIN
MHI	PQI
CN	

BİYOLOJİK
EUD
TCP
NTCP
LYMAN

İLK FORMÜL

Cureus

Open Access
Abstract

Cureus

The Effect of Prescribed Isodose Line on the Treatment Planning Quality for Pituitary Adenoma with A New Planning Quality Index

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AMA

NEDEN nCI SEÇİLDİ ??

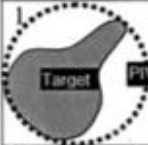
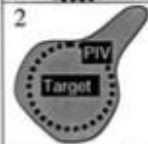
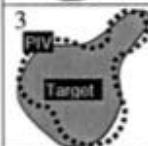
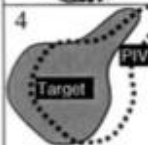
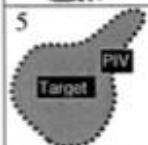
Isodose Plan	Parameters	PITV	RCl _i	Proposed Index	nCI
		$\frac{PIV}{TV}$	$\frac{TV_{PIV}}{TV}$	$\frac{TV_{PIV}^2}{TV \times PIV}$	$TV \times PIV / TV^2$
1 	TV = 5cm ³ TV _{PIV} = 5cm ³ PIV = 10cm ³	2.00	1.00	0.50	2
2 	TV = 5cm ³ TV _{PIV} = 3cm ³ PIV = 3cm ³	0.60	0.60	0.60	1.66
3 	TV = 5cm ³ TV _{PIV} = 4cm ³ PIV = 5cm ³	1.00	0.80	0.64	1.56
4 	TV = 5cm ³ TV _{PIV} = 3cm ³ PIV = 5cm ³	1.00	0.60	0.36	2.77 ???
5 	TV = 5cm ³ TV _{PIV} = 5cm ³ PIV = 5cm ³	1.00	1.00	1.00	1

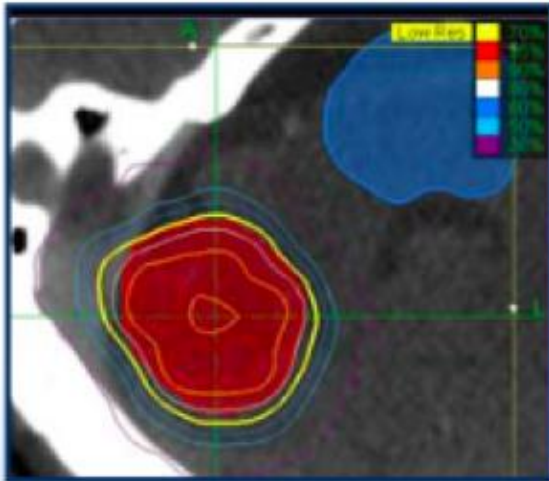
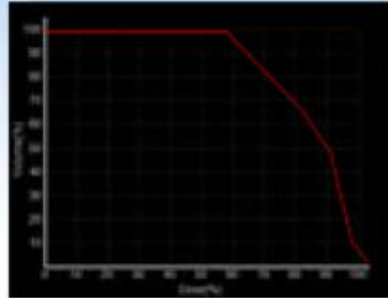
FIG. 5. Comparison of the PITV ratio and the new conformity index for various treatment plans.

PLANDA BAKILAN PARAMETRELER

1. Conformity / PADDICK index / nCI
2. Dose Gradient
3. Coverage
4. Kritik Organın Aldığı Maximum Doz
5. Kritik Organın Aldığı Hacim Dozları
6. Homojenite İndeksi ???

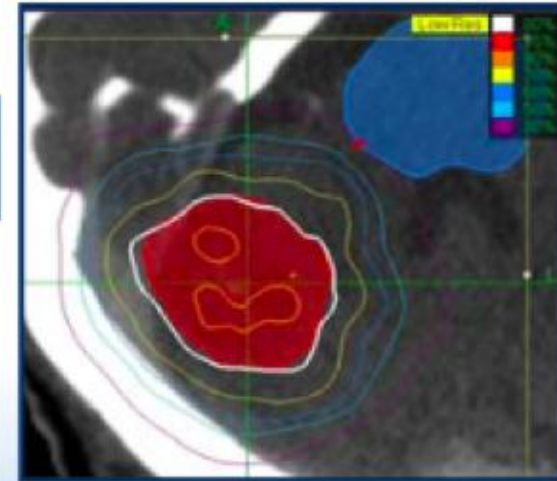
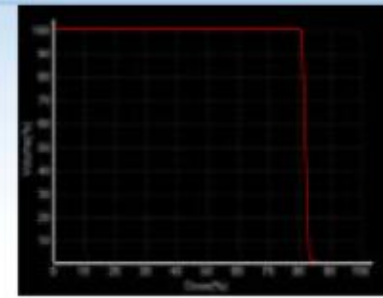
HOMOGENEITY INDEX ??

Homogeneity (continued)



Low degree of Homogeneity =

- High HI value (1.43)
- Closely spaced isodose lines
- Steeper dose gradients



High degree of Homogeneity =

- Low HI value (1.1)
- Widely spread isodose lines
- Gradual dose gradients

$$HI = \frac{D_{\max} (100\%)}{R_x \text{ Dose}}$$

NE KADAR HETEROJEN ??

Results

Model derivation

The calculated dose profiles for different collimator sizes vary. The dose gradient was calculated for different target diameters between 1.06 and 1.26 cm.

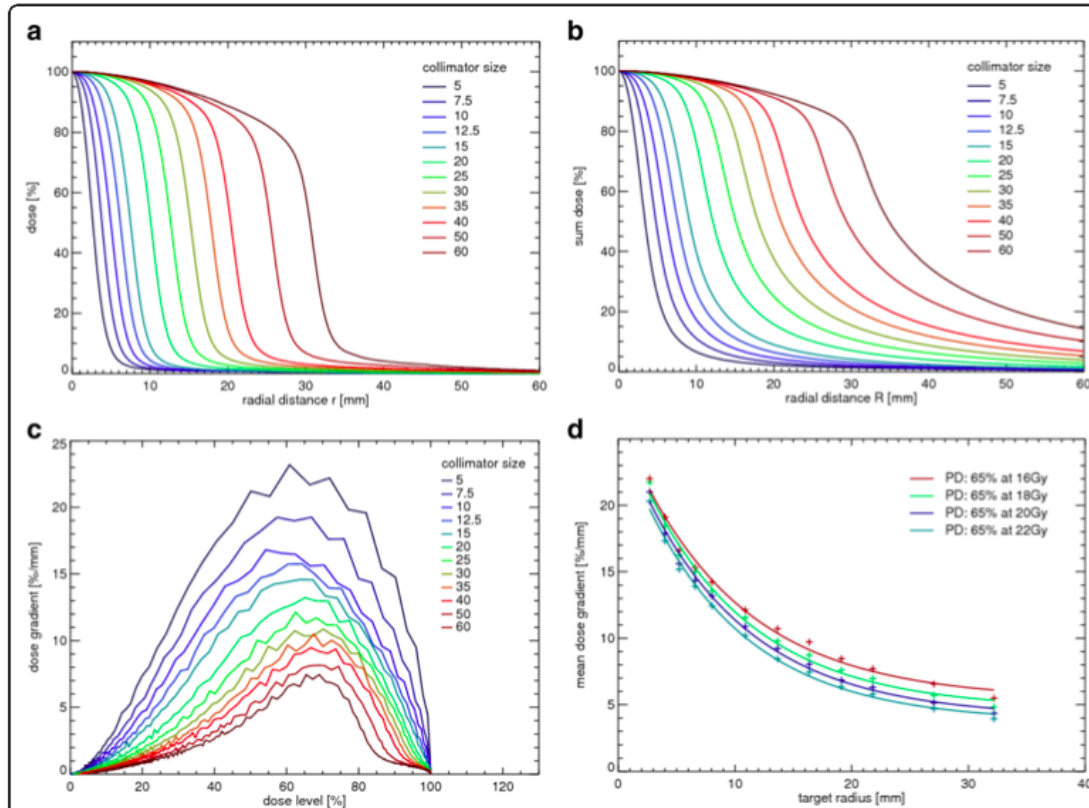


Fig. 1 Derivation of the V12 model **a:** Measured OCR-curves for the 12 available collimator sizes of the CK system at a depth of 10 cm and 80 cm source-detector distance, r is the radial distance of the central axis. **b:** Sum dose profiles calculated by Eq. 3 where R represents the radial distance of the target center. **c:** Gradient of sum dose profiles calculated by numerical differentiation. **d:** Mean values of the dose gradient (in the range between 12 Gy and PD) are plotted as a function of the target radius (approximated by radial distance R of the sum dose profiles at 65%)

For target diameters between 1.06 and 1.26 cm, the dose gradient decreased with increasing target radius (Fig. 1d). Results are shown in Table 1. The calculated dose profiles in the phantom were compared with the predicted dose profiles. The difference was independent of the calculation techniques. For target diameters from 1.06 to 1.26 cm, there was no dependence on the target diameter (range: 91.9% - 97.8%) and the target diameter (range: 97.3% - 100%).

Table 1: Mean values of the dose gradient

Target diameter [mm]	65% at 20 Gy	65% at 22 Gy
692	21.666	
109	-0.113	
67	3.715	
95	0.997	

coefficient of determination

nPQI

1. Conformity / PADDICK index / nCI

- $nCI = PIV \times TV / (TV_{PIV})^2$
- $CI = PIV / TIV$
- $Paddick\ CI = (TV_{PIV})^2 / PIV \times TV$

2. Gradient Index

- $GI = PIV_{half} / PIV$

3. Coverage

- $Coverage = TIV / TV \times 100$

$$nPQI = \underbrace{(TV \times PIV) / (TIV)^2}_{nCI} \times \underbrace{100 / Coverage}_{COVERAGE} \times \underbrace{PIV_{half} / PIV}_{GI} \times \underbrace{\frac{\prod_{i=1}^n \frac{D_i}{Dt}}{n} \times \frac{\prod_{i=1}^n \frac{V_i}{Vt}}{n}}_{= 0 \text{ olmalı!}} \cong 0 \text{ olmalı}$$

= 1 olmalı
= 1 olmalı
<<<
= 0 olmalı !

- Bu çalışmada; aynı hastaya yapılan farklı radyocerrahi tedavi planlarının değerlendirilmesinde nPQI'in doğruluğu araştırılmıştır

- Medicana International Ankara Hastanesi (2013 – 2017 yıl)
- Vestibular schwannoma - 35 hasta seçildi
- Isocentric vs sequential optimizasyonu
- 1x12Gy
- nPQI indeksi ile değerlendirme yapıldı
- Kohlea max dozu < 4.2 Gy, beyin sapı max dozu < 15Gy ve 1cc < 10 Gy
- Radyasyon onkoloğu ve Beyin cerrahına değerler üzerinden isocentric ve sequential planlarından hangisini seçersiniz sorusu yöneltilerek, indeks ve doktorların seçtiği planlar arasındaki % uyuma bakıldı

➤ PQI indeksi bütün parametreler eşit öneme sahip olduğu düşünüldüğünde;

❖ Eğer $nCI > 1$ ise;

$$nPQI = \underbrace{(TV \times PIV) / (TIV)^2}_{nCI} \times \underbrace{100 / \text{Coverage}}_{\text{COVERAGE}} \times \underbrace{PIV_{half} / PIV}_{GI} \times \underbrace{\frac{\prod_{i=1}^n \frac{D_i}{Dt}}{n} \times \frac{\prod_{i=1}^n \frac{V_i}{Vt}}{n}}_{=0 \text{ olmalı !}} \cong 0 \text{ olmalı}$$

$= 1$ olmalı
 $= 1$ olmalı
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❖ Eğer $nCI < 1$ ise;

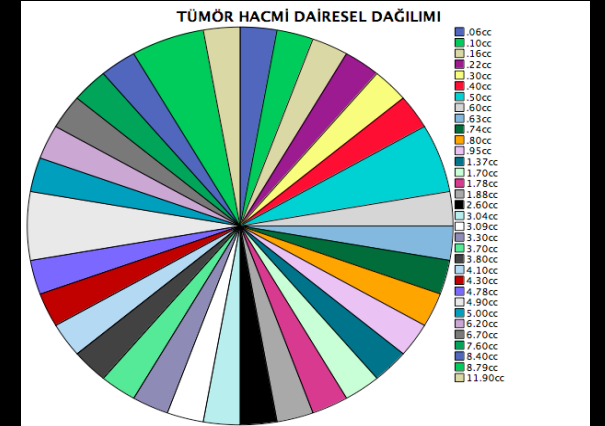
$$nPQI = \underbrace{1 / (TV \times PIV) / (TIV)^2}_{nCI} \times \underbrace{100 / \text{Coverage}}_{\text{COVERAGE}} \times \underbrace{PIV_{half} / PIV}_{GI} \times \underbrace{\frac{\prod_{i=1}^n \frac{D_i}{Dt}}{n} \times \frac{\prod_{i=1}^n \frac{V_i}{Vt}}{n}}_{=0 \text{ olmalı !}} \cong 0 \text{ olmalı}$$

$= 1$ olmalı
 $= 1$ olmalı
 $<<<$

➤ PQI indeksi kritik organlara ağırlık vererek değerlendirildiğinde;

	NAKAMURA CI	COVERAGE	GI	KRİTİK ORGAN	
PQI	$(TV \times PIV) / (TIV)^2$	100 / Coverage	PIV_{half} / PIV	$\frac{\prod_{i=1}^n \frac{D_i}{Dt}}{n} \times \frac{\prod_{i=1}^n \frac{V_i}{Vt}}{n}$	
	1/4	1/4	1/4	1/4	eşit ağırlıklı
	2/8	2/8	3/8	1/8	Kritik organ ağırlıklı
	2/8	3/8	1/8	1/8 / 1/8	Coverage ağırlıklı
	2/8	1/8	2/8	1/8 / 2/8	Coverage ve kritik organ ağırlıklı

- Tümör hacim ortalama :3.29cc (0.06cc-11.9cc)
- Tümör hacim median : 2.82cc (0.06cc-11.9cc)
- Isocentric PQI ortalama : 4.73
- sequential PQI ortalama : 1.11
- Bütün parametreler eşit alındığında : PQI – Doktor uyumu = %94.44 (2 plan tercih edilmedi)
 - Küçük hacimli planlarda (0.06cc – 0.1cc) kohlea ve beyin sapı dozları isocentric’ de daha düşük sonuç verdi
- Kritik organ ağırlık faktörü kullanılarak : PQI - Doktor uyumu = %100



- nPQI indeksi ile birden fazla tedavi planlarının değerlendirilmesinde nümerik bir değer elde ederek daha uygun planların seçileceğini gösterdik
- Geliştirilen bu indeks sadece CyberKnife cihazında değil linak tabanlı cihazlarda da kullanılabilir ve geliştirilebilir

TEŞEKKÜRLER