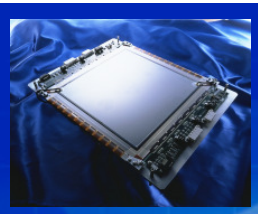
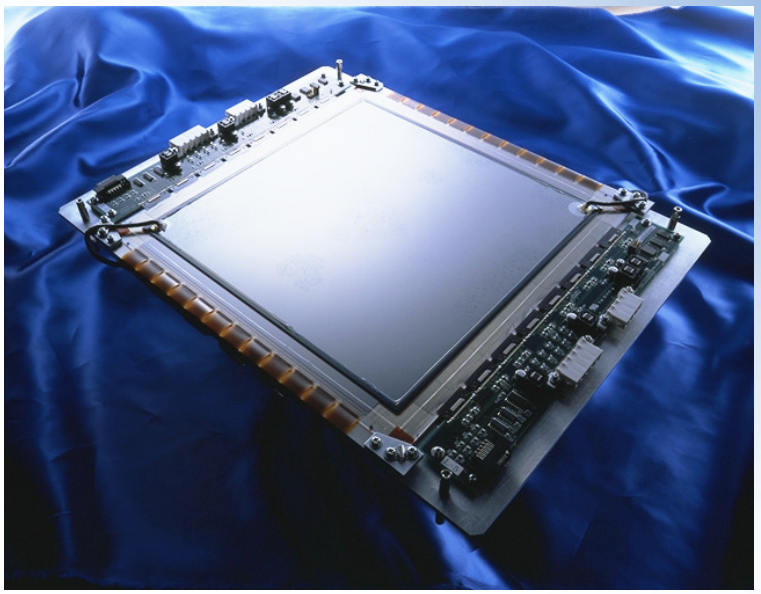
TOSHIBA

Titel



GEMEINSAM DAS RICHTIGE TUN



Neue (und alte) Aspekte und Systemkonzepte mit Flatpanel Technologie

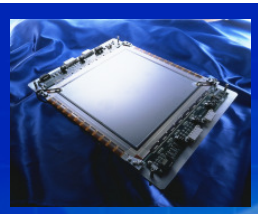
Joachim Engemann

TOSHIBA

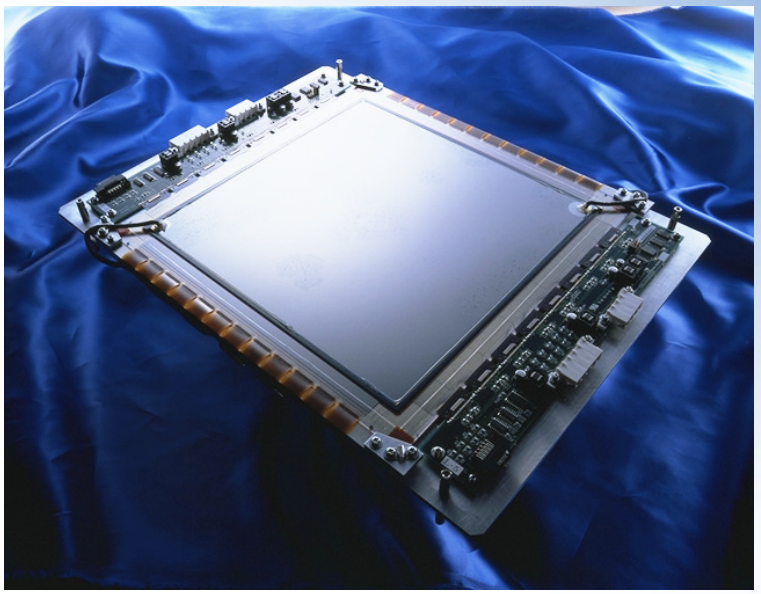
Imaging process （X-ray→ image）

TOSHIBA

Imaging process （X-ray→ image）



GEMEINSAM DAS RICHTIGE TUN



Materialien für FP-Detektoren:

- HgJ_2
- CdZnTe
- Cd_2O_2S
- PbJ_2
- PbO
- **CsJ** **Caesiumjodid**
- **aSe** **amorphes Selen**

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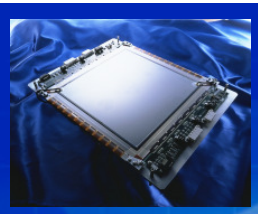
Imaging process （X-ray→ image）



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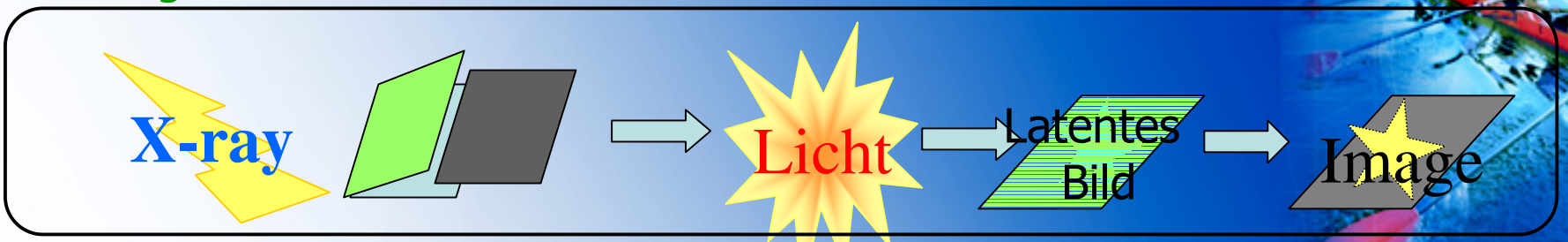
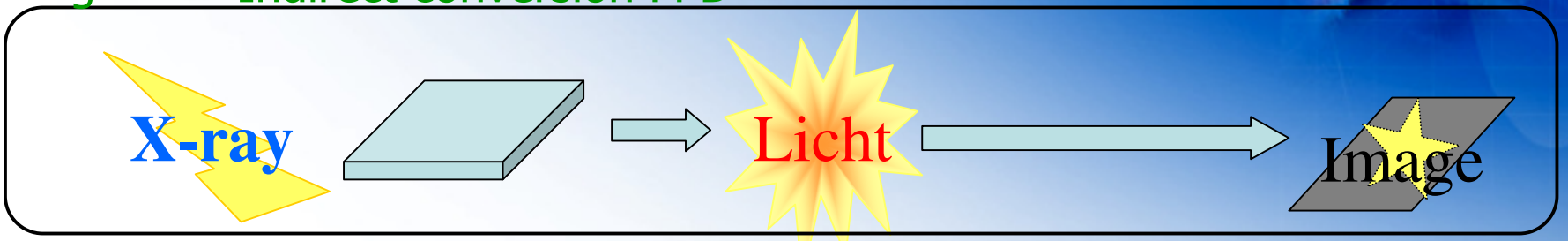
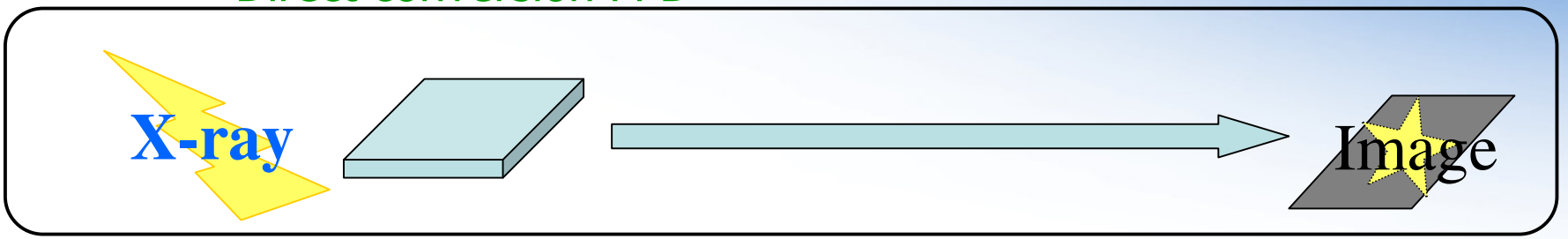
■Analog　Screen＆Film



■Digital　Indirect conversion FPD

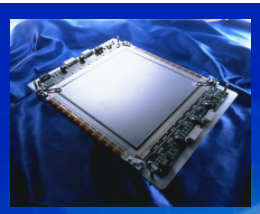


Direct conversion FPD

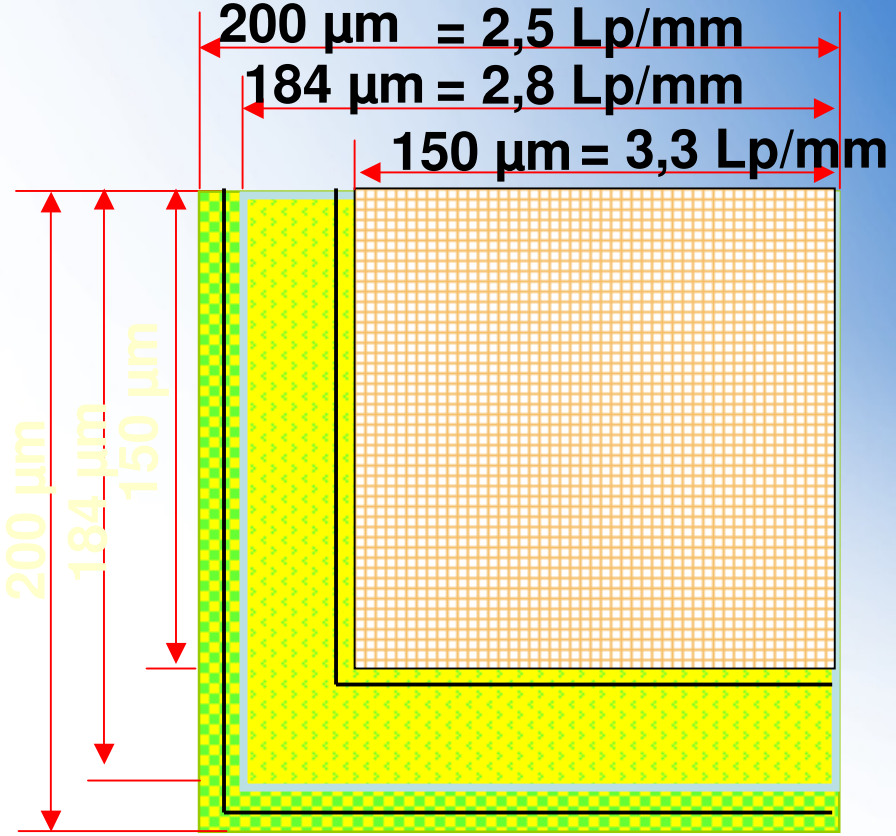


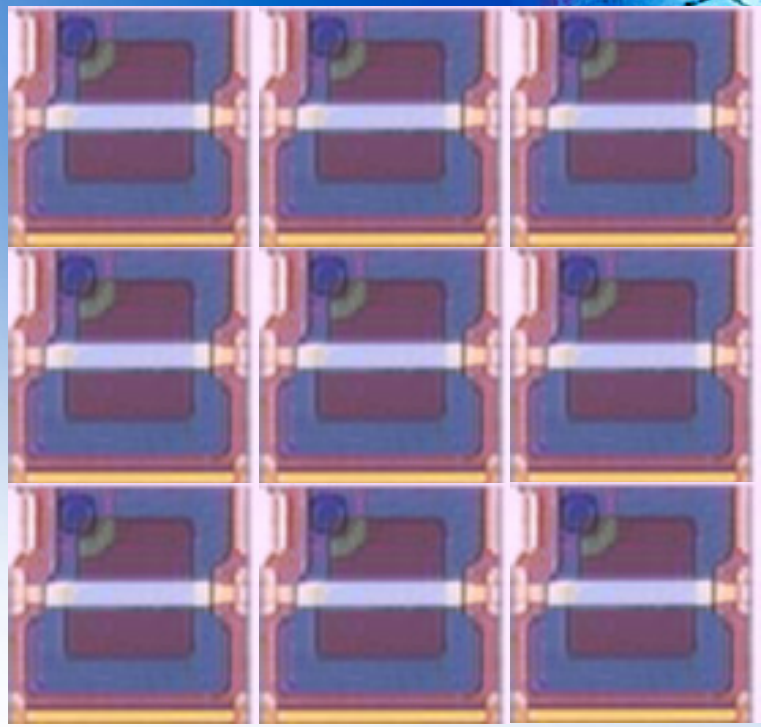
TOSHIBA

Bildempfänger



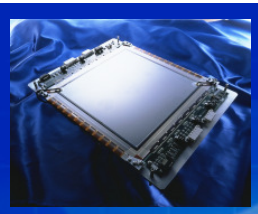
GEMEINSAM DAS RICHTIGE TUN





$$\text{Phys. Auflösung (Lp/mm)} = \frac{1}{2 \times \text{Pixelgröße}}$$

TOSHIBA



Imaging process （X-ray→ image）

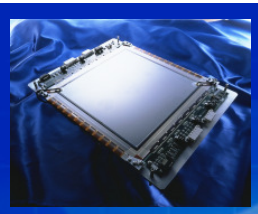
GEMEINSAM DAS RICHTIGE TUN

Detector	DQE(0)
Screen/Film	20 – 40 %
Storage Phosphor	20 – 40 %
CsI FPD	60 – 70 %
Se FPD	50 – 70 %

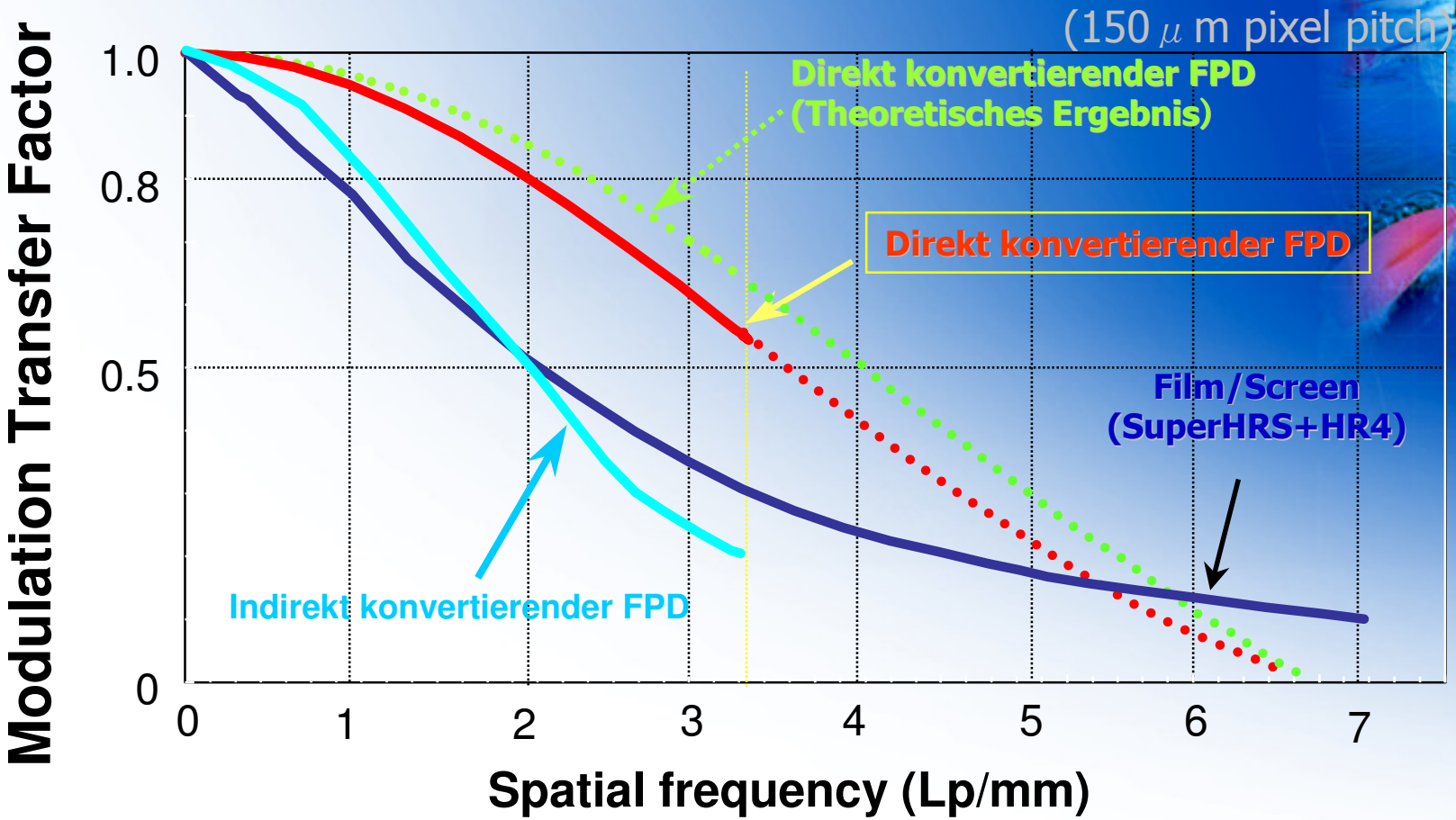
CsI 400 µm 70%; Se 1000 µm 70%

TOSHIBA

Spatial Frequenz Charakteristik



GEMEINSAM DAS RICHTIGE TUN



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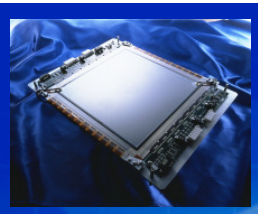
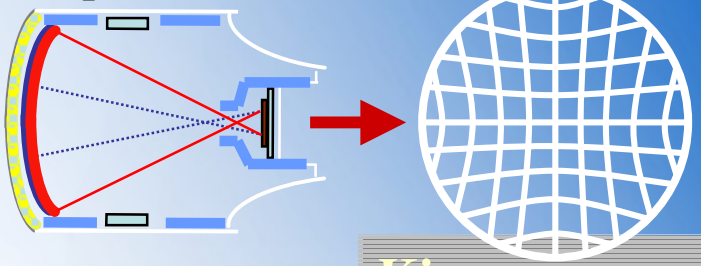
Bildempfänger

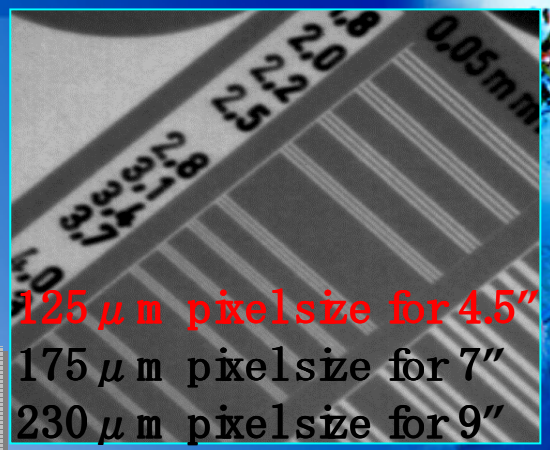


GEMEINSAM DAS RICHTIGE TUN

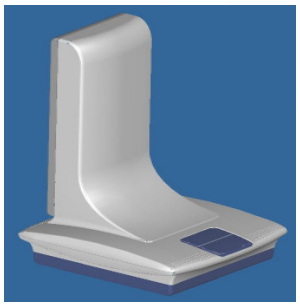
Optisches-, Magnetisches-
& Optisches Feld



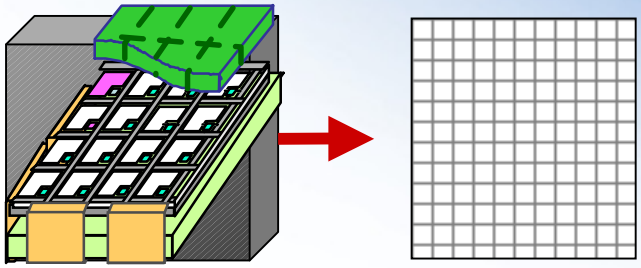
Kissen-
verzeichnung

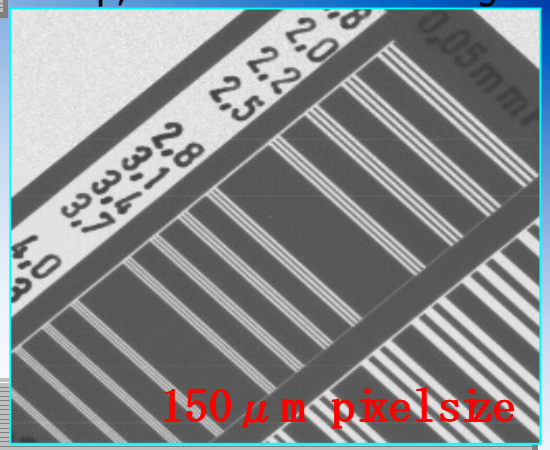


60kVp, 1.6mAs for both images



Diskrete Elemente

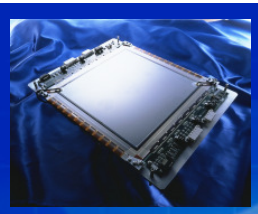




Keine
Verzeichnung und höhere Auflösung

TOSHIBA

Material und Methodik



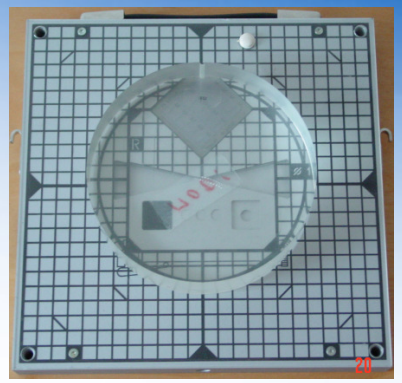
GEMEINSAM DAS RICHTIGE TUN

Die Untersuchungen wurden an klinischen Systemen für die Angiographie (Ultimax, TMSC) durchgeführt. Verwendet wurde je ein Festkörperdetektor (DynaDirect, 150 µm) 36 cm **x** 36 cm Gesichtsfeld sowie ein Bildverstärker mit 40 cm Durchmesser.

Als Prüfkörper wurde eingesetzt:

Cathpan 123, The Phantom Laboratory, New York
Gewebeäquivalente Kunststoffplatte, 150 mm Durchmesser, 40 mm hoch
Eingebettet sind: 4 Perlenreihen à 0,36 mm im Winkel von 45°
2 Perlenreihen à 0,18 mm im Winkel von 23°
2 Perlen à 0,36 mm im Abstand von 40 mm

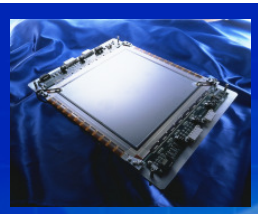
PTW 26761, PTW, Freiburg
Aluminiumblock, 250 x 250 x 25 mm
Eingebettet sind: 10 mm Raster,140 mm Kreis,
Hoch- und Niedrigkontrastfelder
Auflösungsphantom



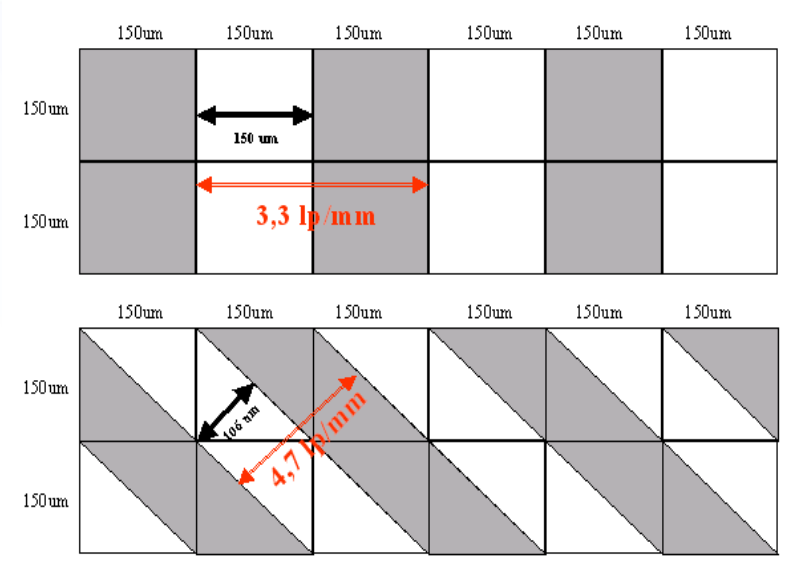
Liberté Stent, Boston Scientific, Ratingen
Länge 16 mm, Durchmesser 3 mm, Strebenstärke 0,096 mm

TOSHIBA

Visuelle Auflösung (Lp/mm)



GEMEINSAM DAS RICHTIGE TUN



Standardtest zur Auflösung bei BV:
Bleistrichraster 45° zur Horizontalen

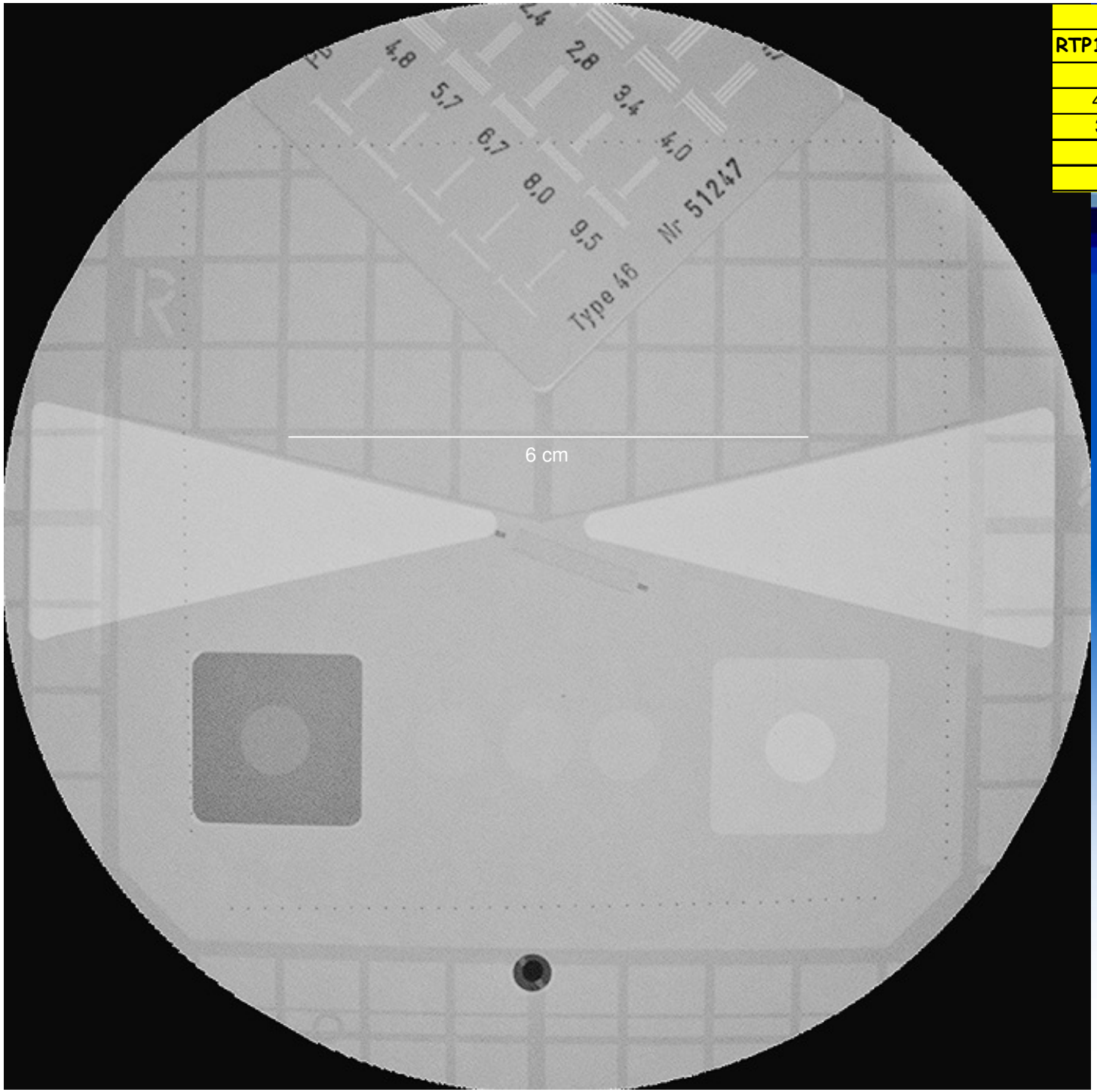
cos von 150 = 106

$f_{N\ vis}$ = 1 / (2x 106) = 4,7 Lp/mm

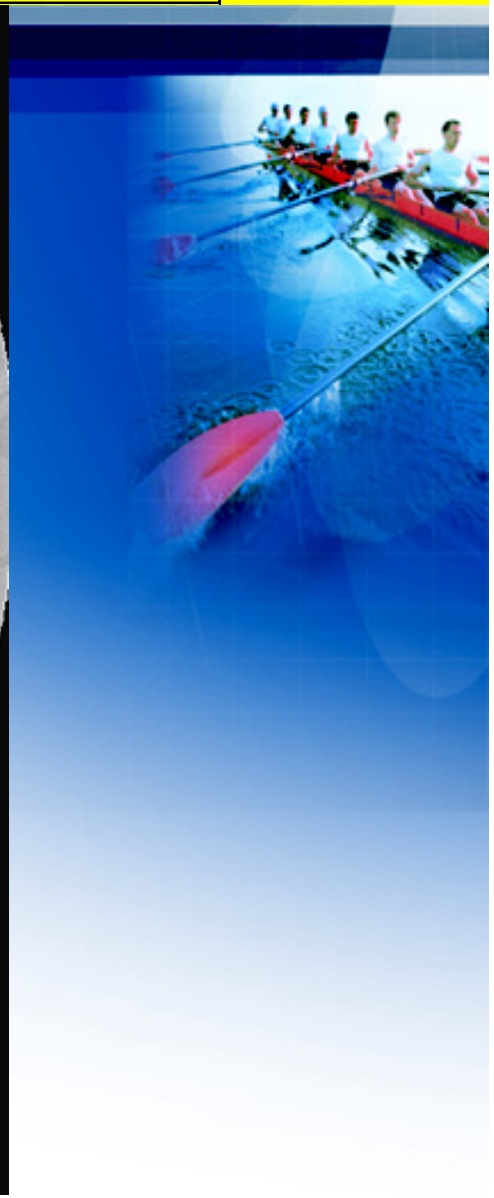
Die Interpretation der Abbildung von periodischen Strukturen mit Frequenzen nahe der Nyquistfrequenz wird durch Phaseneffekte / Aliasing erschwert.

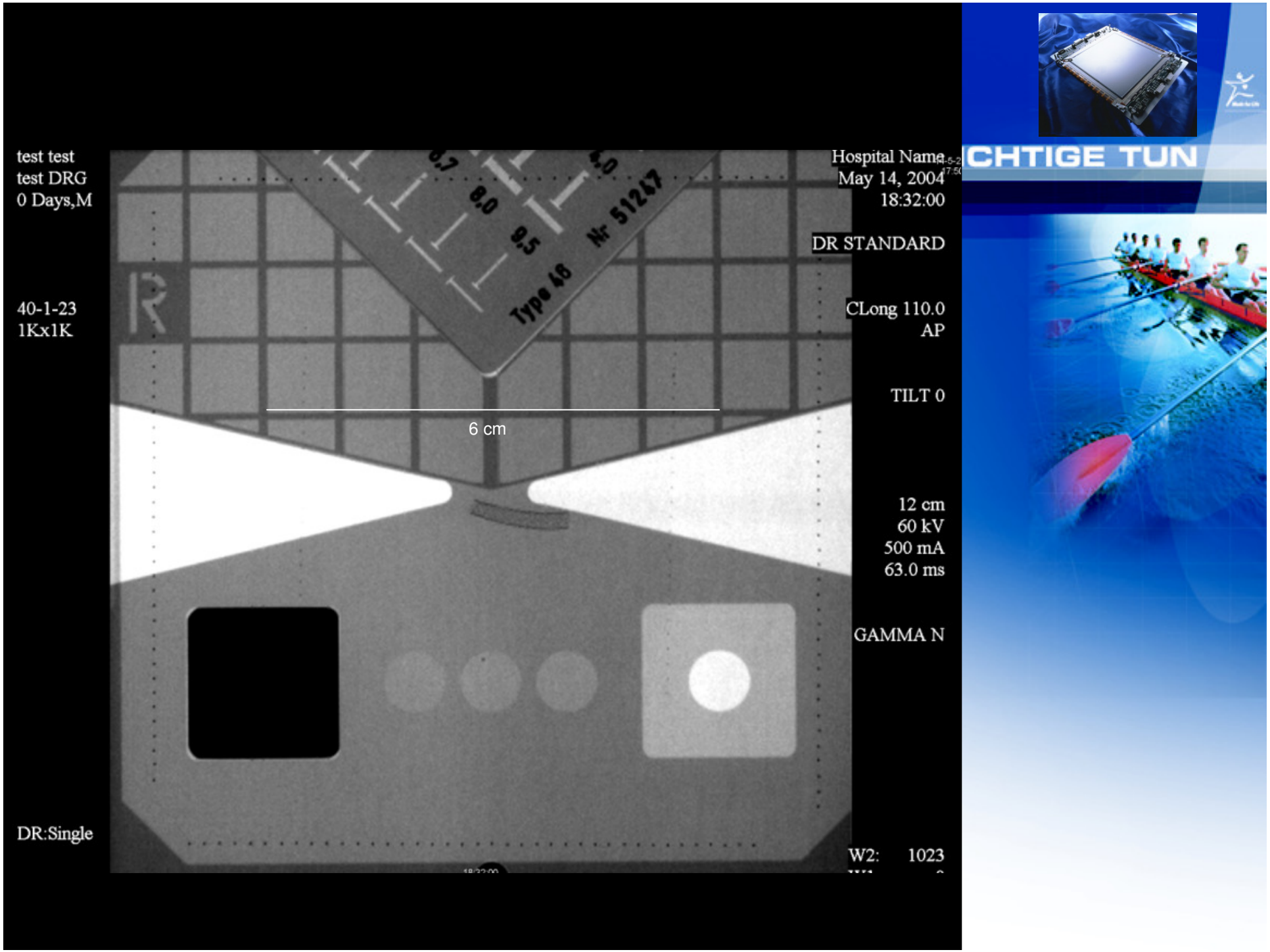
Durch die diagnoale Anordnung wird die effekive Nyquistfrequenz um den Faktor √ 2 (1,414) erhöht, inwieweit dies zu einer Erhöhung der visuellen Auflösungsgrenze führt hängt **insbesondere** von den eingesetzten Algorithmen zur digitalen Bildnach-bearbeitung/ - darstellung ab.

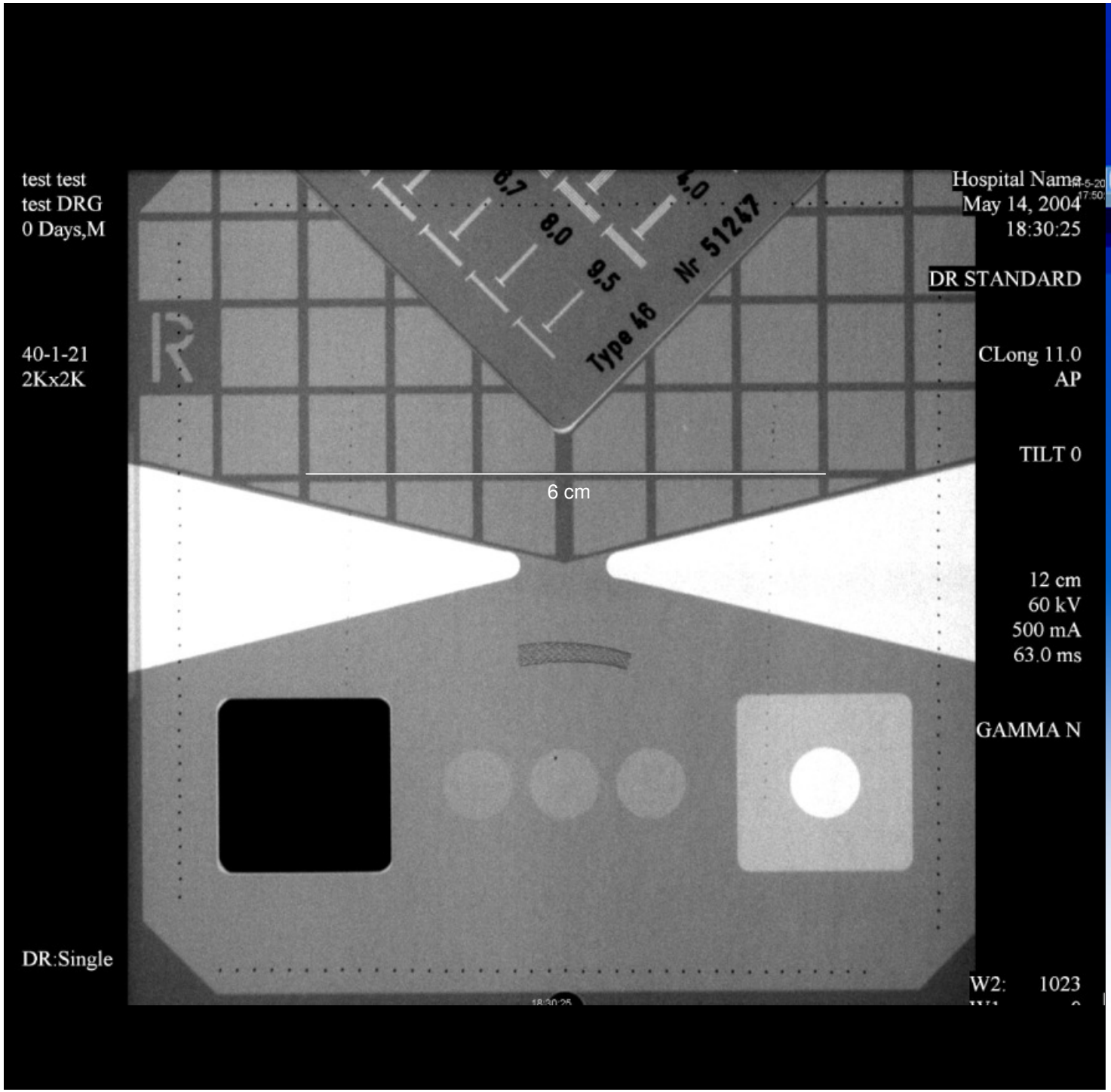
Max. theoretische Auflösung bei Pixelgröße 150 µm (visuell):
$f_{N\ phy}$ = 1 / (2x 150) = 3,33 Lp/mm * 1,414 = 4,7 LP/mm



RTP16031J-G1E/A	Gesichtsfeld mm	Gesichtsfeld Matrix	Pixel µm
40 cm			
400 mm (16")	400	1024	391
300 mm(12")	300	1024	293
230 mm (9")	230	1024	225
155 mm (6")	155	1024	**151**



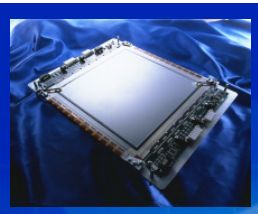

test test
test DRG
0 Days,M
40-1-23
1Kx1K
DR:Single
Hospital Name
May 14, 2004
18:32:00
DR STANDARD
CLong 110.0
AP
TILT 0
12 cm
60 kV
500 mA
63.0 ms
GAMMA N
W2: 1023
6 cm
Typo 48
Nr 51247
CHTIGE TUN


test test
test DRG
0 Days,M
40-1-21
2Kx2K
DR:Single
Hospital Name
May 14, 2004
18:30:25
DR STANDARD
CLong 11.0
AP
TILT 0
12 cm
60 kV
500 mA
63.0 ms
GAMMA N
W2: 1023
6 cm
Type 46
Nr 51247

CHTIGE TUN

TOSHIBA

Dosisreduktion



GEMEINSAM DAS RICHTIGE TUN

Juli 2004

Bildverstärker-Fernsehkette

Digitale Radiographie			
BV-Größe	µGy/B	LP/mm	
Normal	0,8	1,2	40, eff. 36 cm
M1	1	1,4	30 cm
M2	1,4	1,8	23 cm
M3	1,8	2,2	15 cm

Digitale Angio / DAS

Nr.	kV	Dosis/Bild (µGy)	Dynamik-bereich >15	Kontrast bei 0,05 Al (mmCu)	Auflösung
1	80	1,8	i.O.	0	1,2
2	80	2,4	i.O.	3	1,4
3	80	3,2	i.O.	3	1,8
4	80	4,2	i.O.	0	2,2

Februar 2005

Dynamischer Flat Panel Detektor

Digitale Radiographie			
BV-Größe	µGy/B	LP/mm	
Normal	0,5	3,1	36, eff. 34 cm
M1	0,7	3,4	28 cm
M2	0,82	3,7	23 cm
M3	0,95	4	18 cm

Digitale Angio / DAS

Nr.	kV	Dosis/Bild (µGy)	Dynamik-bereich >15	Kontrast bei 0,05 Al (mmCu)	Auflösung
1	80	1,4	i.O.	0	3,1
2	80	2,0	i.O.	3	3,4
3	80	2,5	i.O.	3	3,7
4	80	2,8	i.O.	0	4

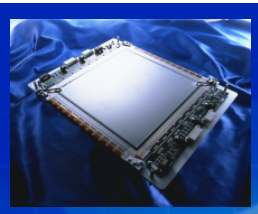
Dosisreduktion

~ 30 %

Bei gleichzeitiger Verdoppelung der Auflösung !!!

TOSHIBA

Dosisreduktion



GEMEINSAM DAS RICHTIGE TUN

Juli 2004

Bildverstärker-Fernsehkette

Digitale Radiographie			
BV-Größe	µGy/B	LP/mm	
Normal	0,8	1,2	40, eff. 36 cm
M1	1	1,4	30 cm
M2	1,4	1,8	23 cm
M3	1,8	2,2	15 cm

Digitale Angio / DAS

Nr.	kV	Dosis/Bild (µGy)	Dynamik-bereich >15	Kontrast bei 0,05 Al (mmCu)	Auflösung
1	80	1,8	i.O.	0	1,2
2	80	2,4	i.O.	3	1,4
3	80	3,2	i.O.	3	1,8
4	80	4,2	i.O.	0	2,2

Februar 2005

Dynamischer Flat Panel Detektor

Digitale Radiographie			
BV-Größe	µGy/B	LP/mm	
Normal	0,5	3,1	36, eff. 34 cm
M1	0,7	3,4	28 cm
M2	0,82	3,7	23 cm
M3	0,95	4	18 cm

Digitale Angio / DAS

Nr.	kV	Dosis/Bild (µGy)	Dynamik-bereich >15	Kontrast bei 0,05 Al (mmCu)	Auflösung
1	80	1,4	i.O.	0	3,1
2	80	2,0	i.O.	3	3,4
3	80	2,5	i.O.	3	3,7
4	80	2,8	i.O.	0	4

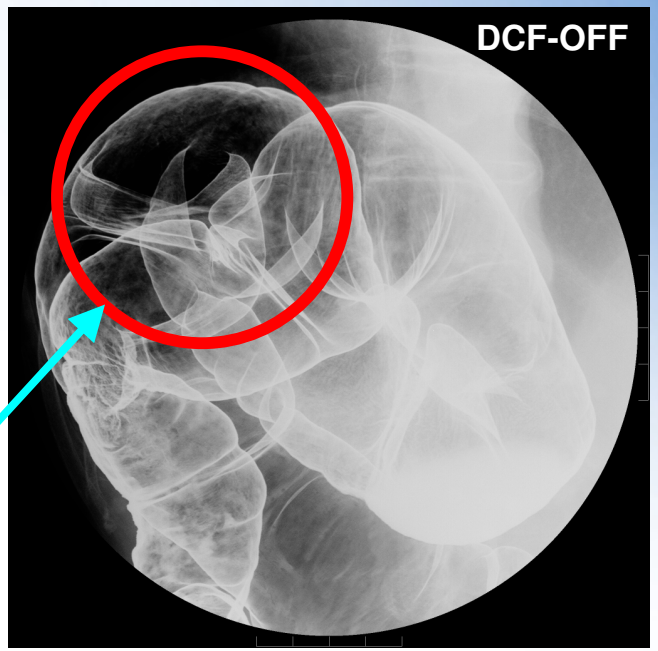
Tab. I.2: Beispiele für die Grenzwerte der Bildempfängerdosis K^d_B und –dosisleistung $\dot{K}^d_B$ für verschiedene BV-Durchmesser d (gilt nicht für Zoom)

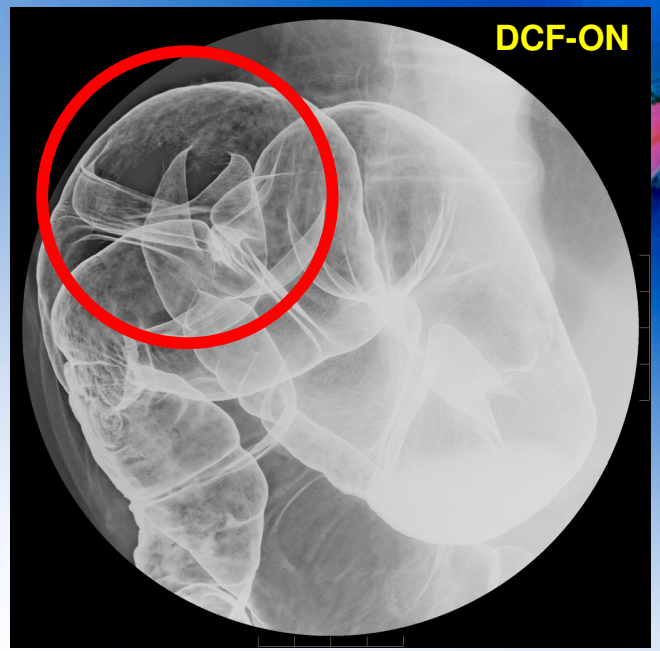
Betriebsart	Messgröße	Grenzwert bei BV-Durchmesser d				
		15 cm	25 cm	30 cm	36 cm	38 cm
Digitale und konventionelle (analoge) Durchleuchtung	$\dot{K}^d_B$ (µGy/s)	0,6	0,6	0,42	0,29	0,26
Digitale BV Radiographie	K^d_B (µGy/B)	2,0	2,0	1,39	0,97	0,87
DSA, Pulse Mode	K^d_B (µGy/B)	5,0	5,0	3,47	2,41	2,16
Kino	K^d_B (µGy/B)	0,2	0,2	0,14	0,10	0,09
Mittelformattechnik	K^d_B (µGy/B)	4,0	4,0	2,78	1,93	1,73

Für Halbleiterdetektoren anstelle von Bildverstärkern müssen sich die Grenzwerte für die Bildempfängerdosis und –dosisleistung an den Werten für den BV-Durchmesser 25 cm orientieren.

Die Toshiba FP-Detektor im Vergleich zum BV erreicht mit ~ ¼ der Grenzwertdosis das 2 – 3fache an Auflösung!

Adequate processing for images containing both high-density and low-density



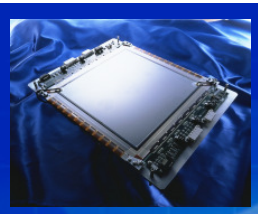


Zu dunkel

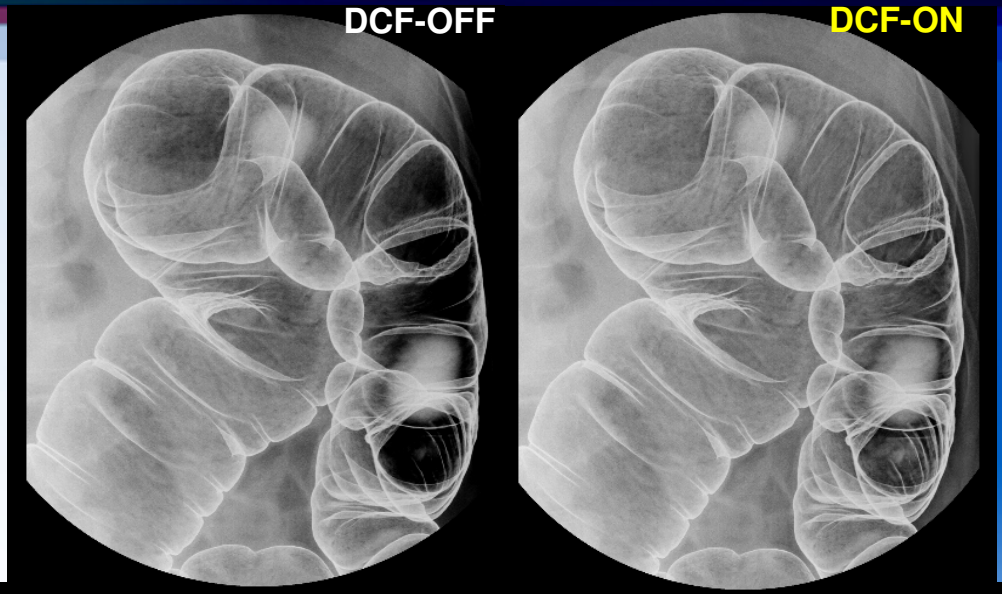
The high-density areas are more clearly demonstrated without reducing image contrast.

TOSHIBA

Digital Compensation Filter 'DCF' für Fluorographie und für Fluoroskopie

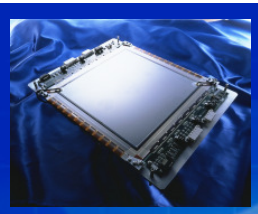


GEMEINSAM DAS RICHTIGE TUN

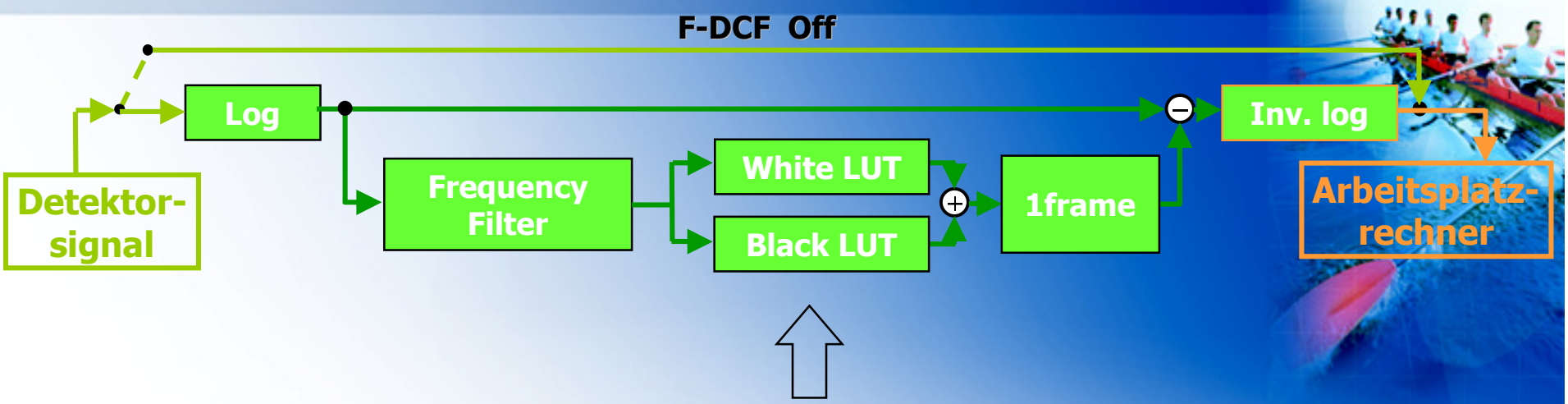


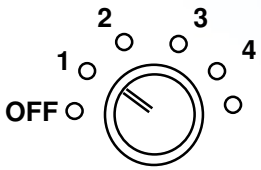
TOSHIBA

Digital Compensation Filter 'DCF' für Fluorographie und für Fluoroskopie



GEMEINSAM DAS RICHTIGE TUN





Lookup Table for Compression Strength

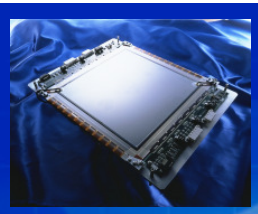
F-DCF Knob	White LUT	Black LUT
OFF	Through	Through
1	0～F	0～F
2	0～F	0～F
3	0～F	0～F
4	0～F	0～F

Selectable by user

Preset by service engineer

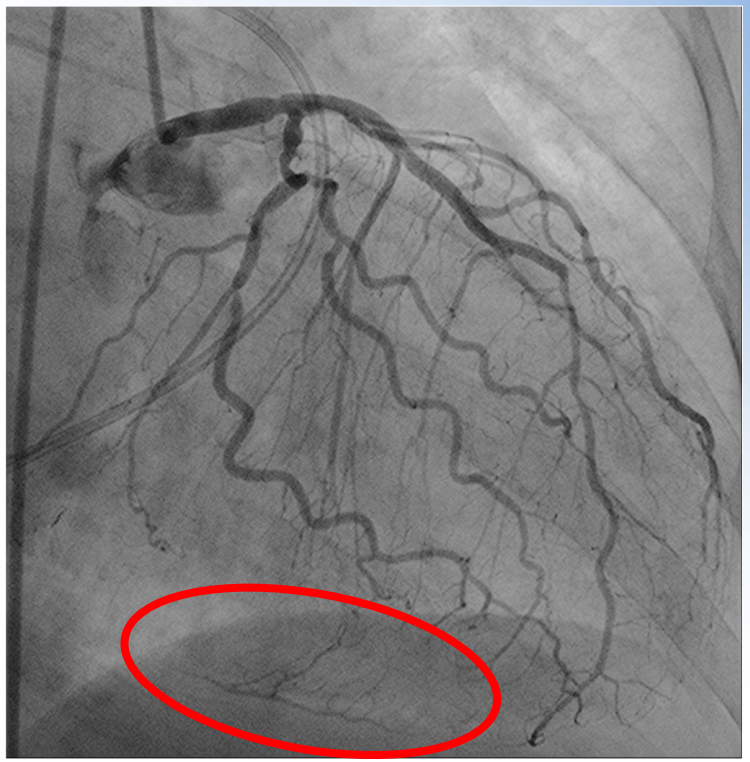
TOSHIBA

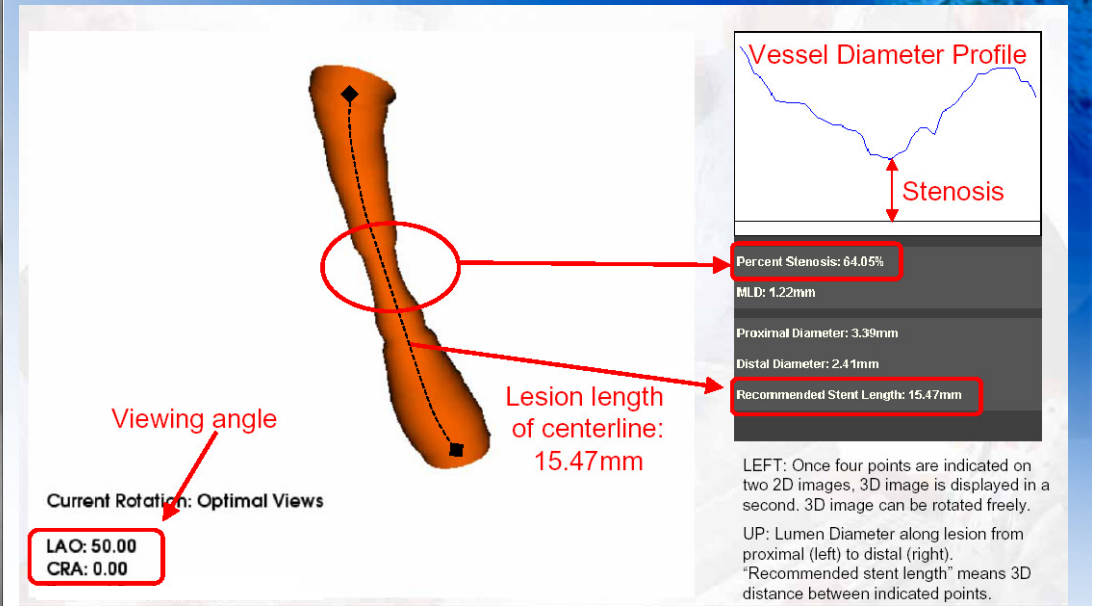
Neue klinische Anwendungen



GEMEINSAM DAS RICHTIGE TUN

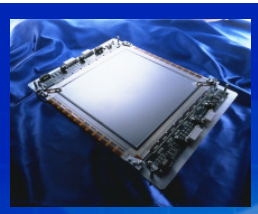
Coronary 3D Imaging of single-vessel



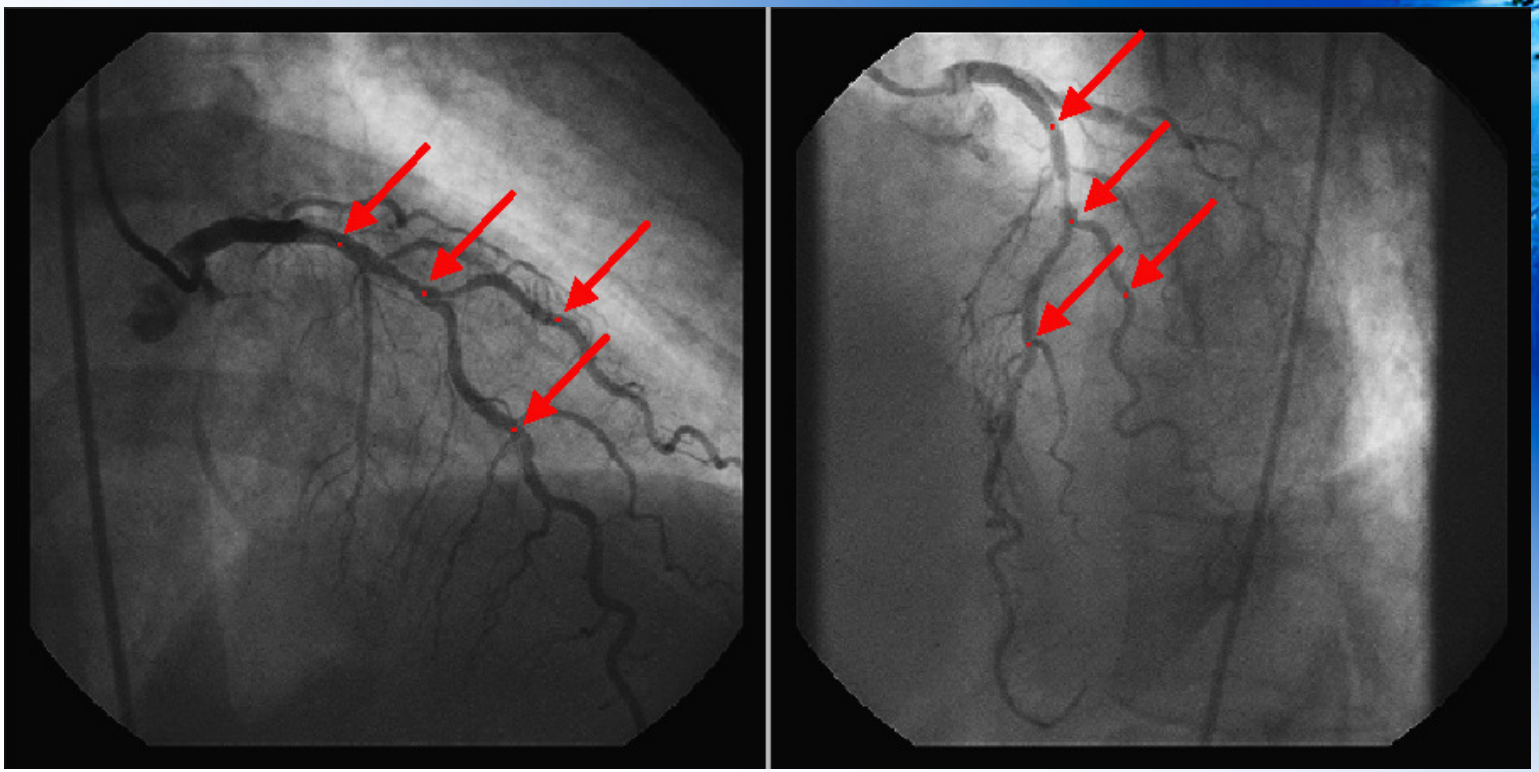


TOSHIBA

Neue klinische Anwendungen



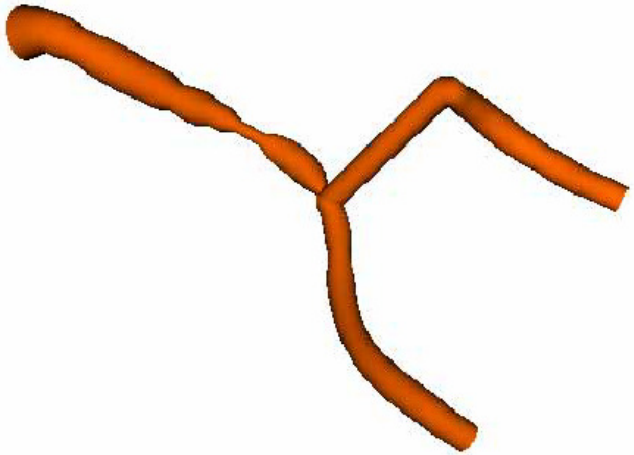
GEMEINSAM DAS RICHTIGE TUN



TOSHIBA

Neue klinische Anwendungen

GEMEINSAM DAS RICHTIGE TUN



Current Rotation: Optimal Views

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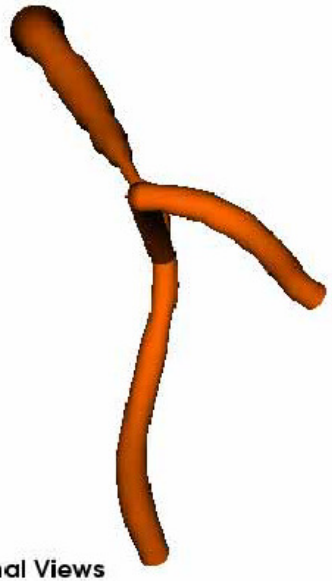
CRA: 10.00

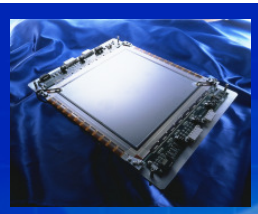


Current Rotation: Optimal Views

LAO: 38.00
CRA: 31.00

TOSHIBA

Neue klinische Anwendungen



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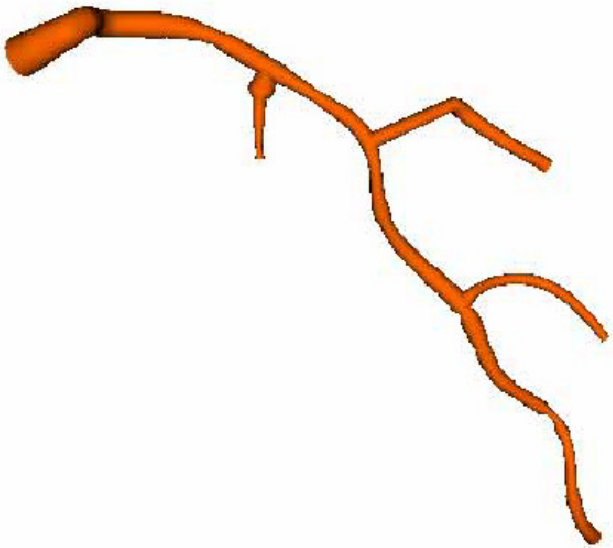


Current Rotation: RAO/LAO

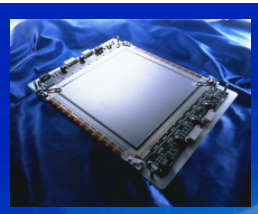
RAO: 24.00
CRA: 24.00

Current Rotation: RAO/LAO

LAO: 38.00
CRA: 31.00

TOSHIBA

Neue klinische Anwendungen

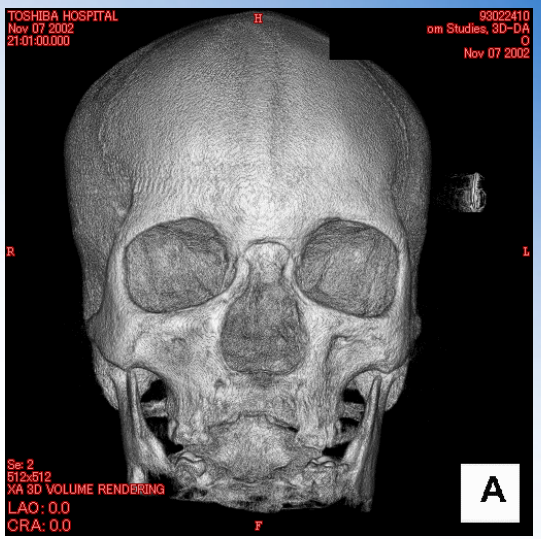


GEMEINSAM DAS RICHTIGE TUN

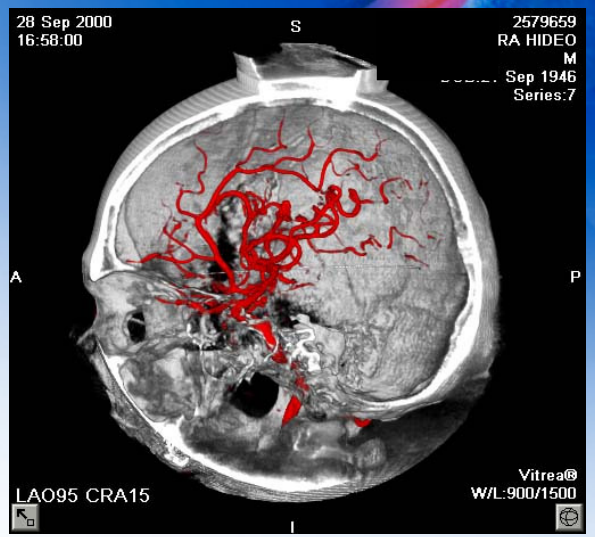
3D ANGIO

Bone-Fusion IMAGING

Vessel-only



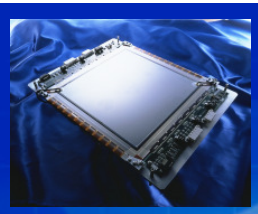
Bone-only



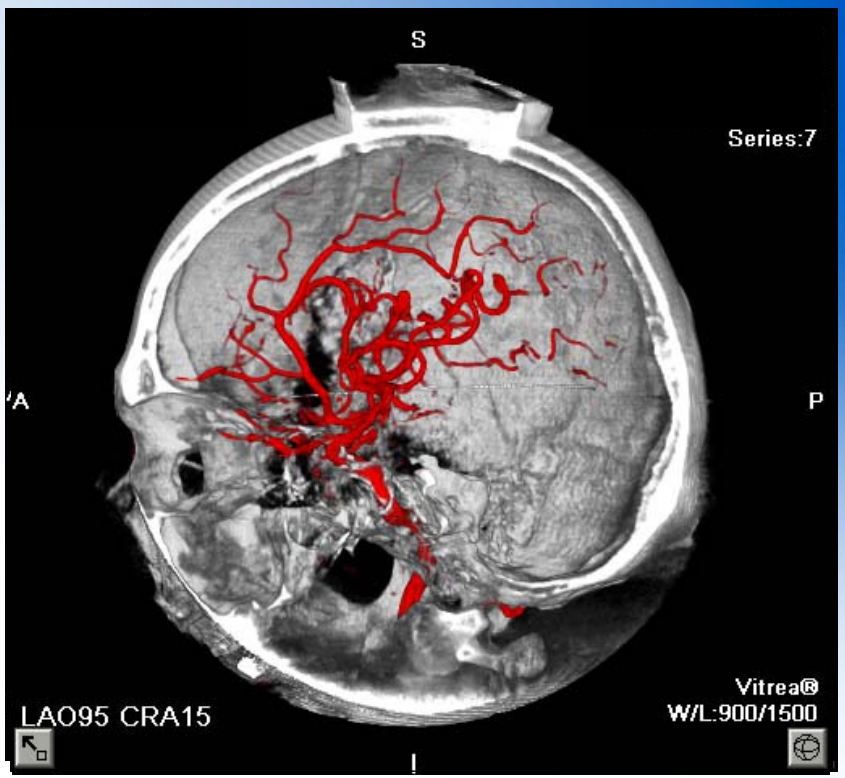
Fusion

TOSHIBA

Neue klinische Anwendungen

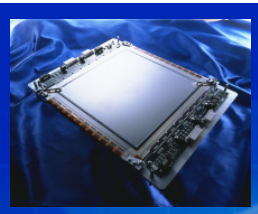


GEMEINSAM DAS RICHTIGE TUN

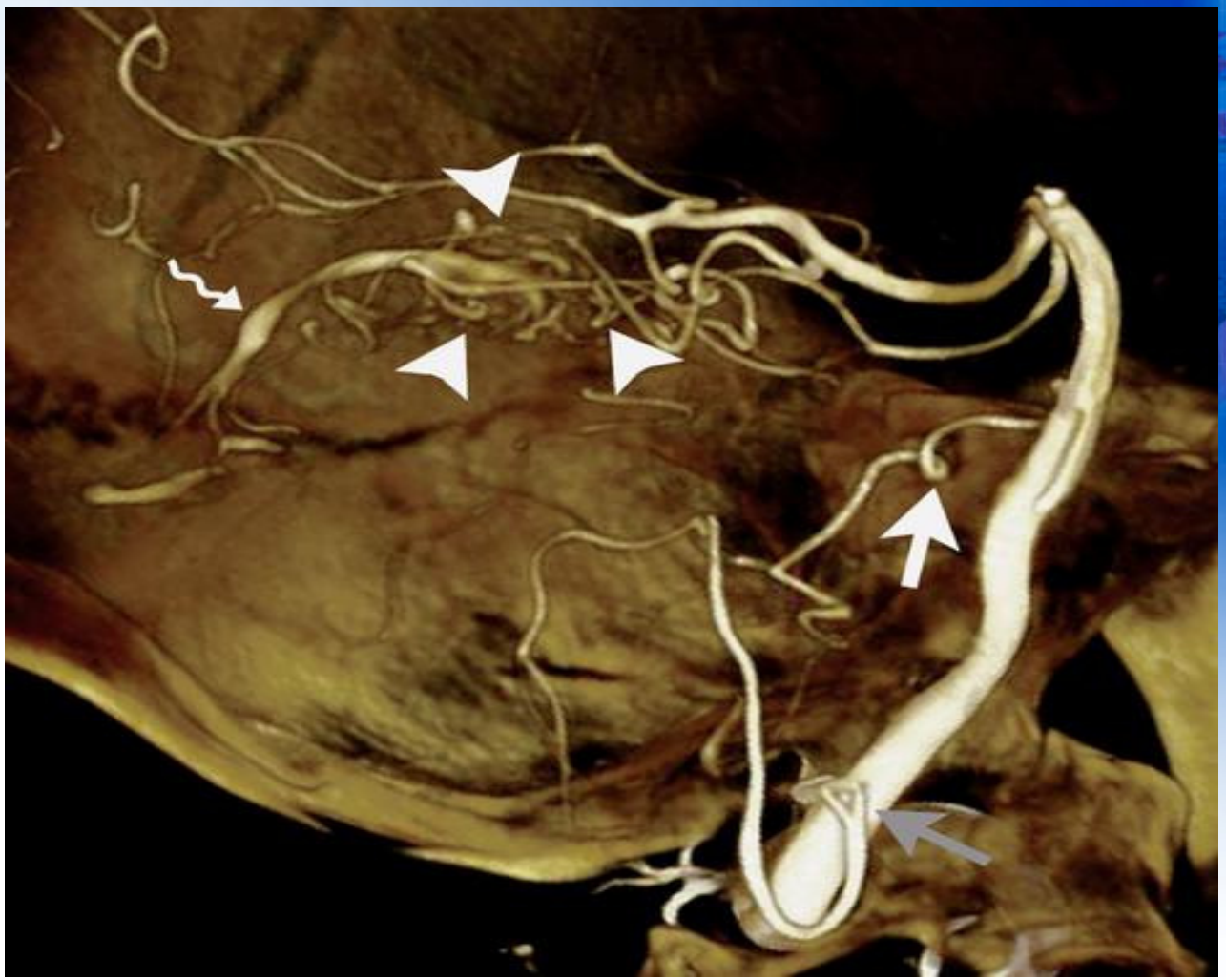


TOSHIBA

Neue klinische Anwendungen

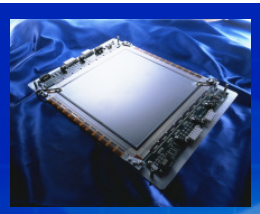


GEMEINSAM DAS RICHTIGE TUN



TOSHIBA

Neue klinische Anwendungen



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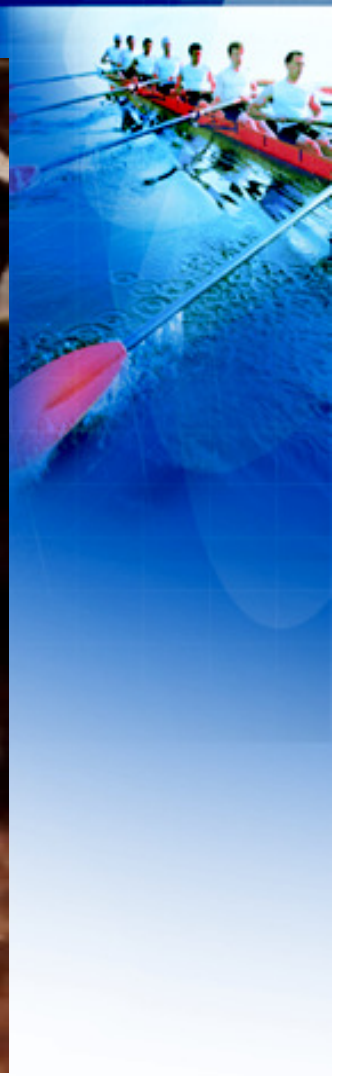

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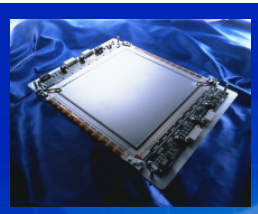

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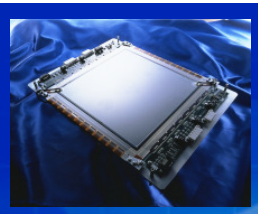
TOSHIBA

Neue klinische Anwendungen



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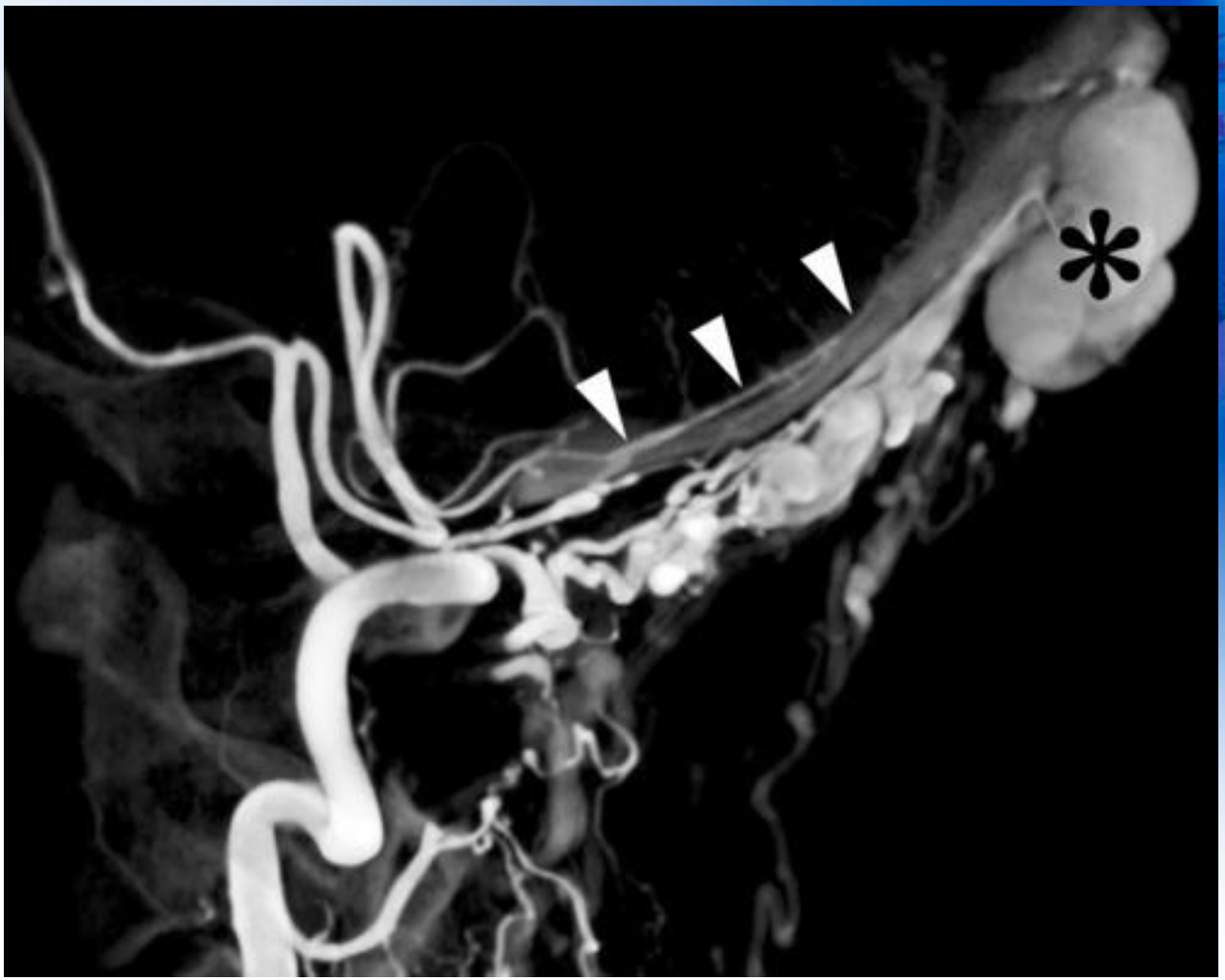
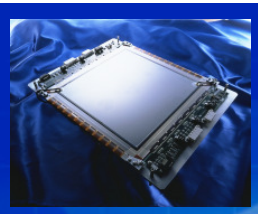


TOSHIBA

Neue klinische Anwendungen



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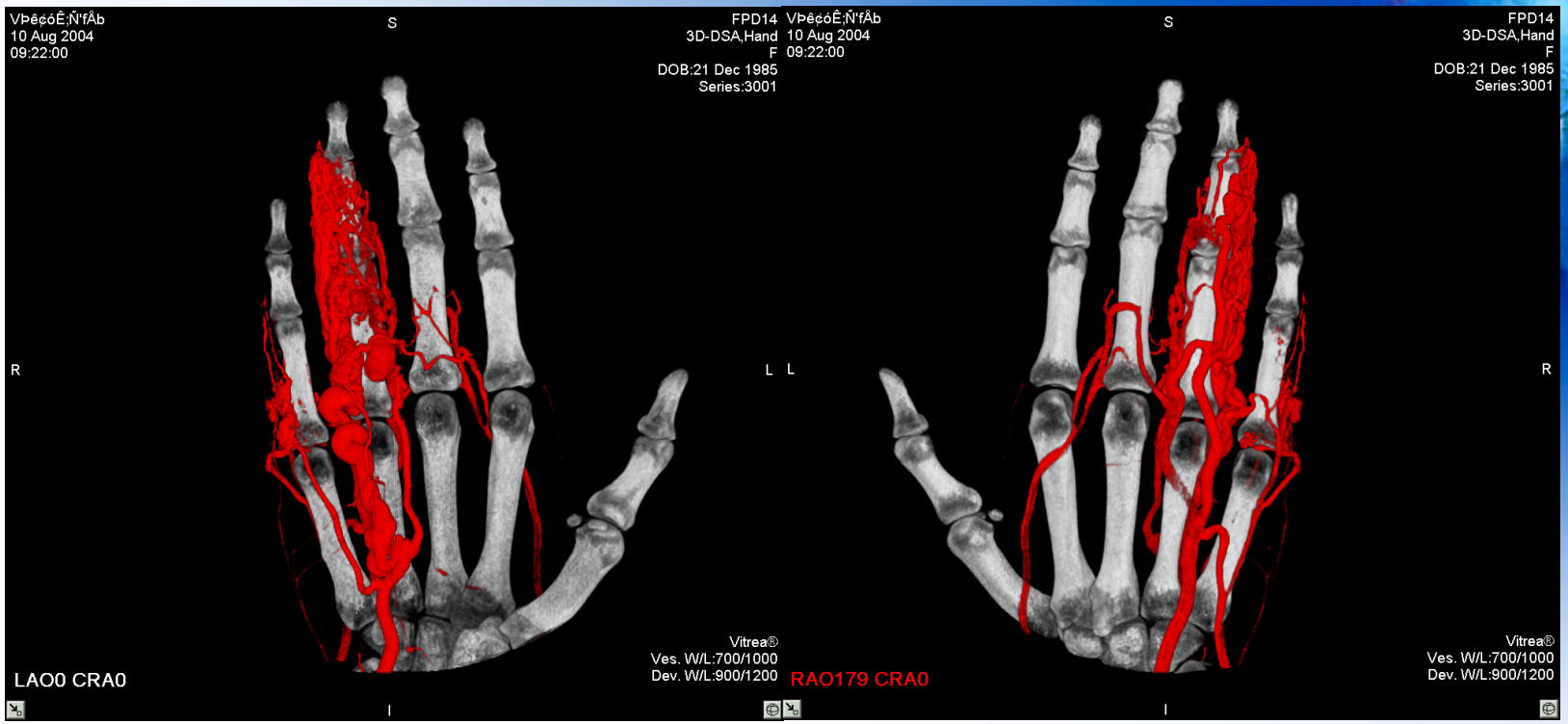
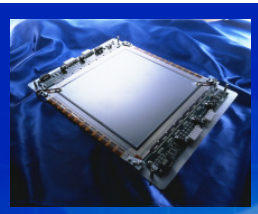
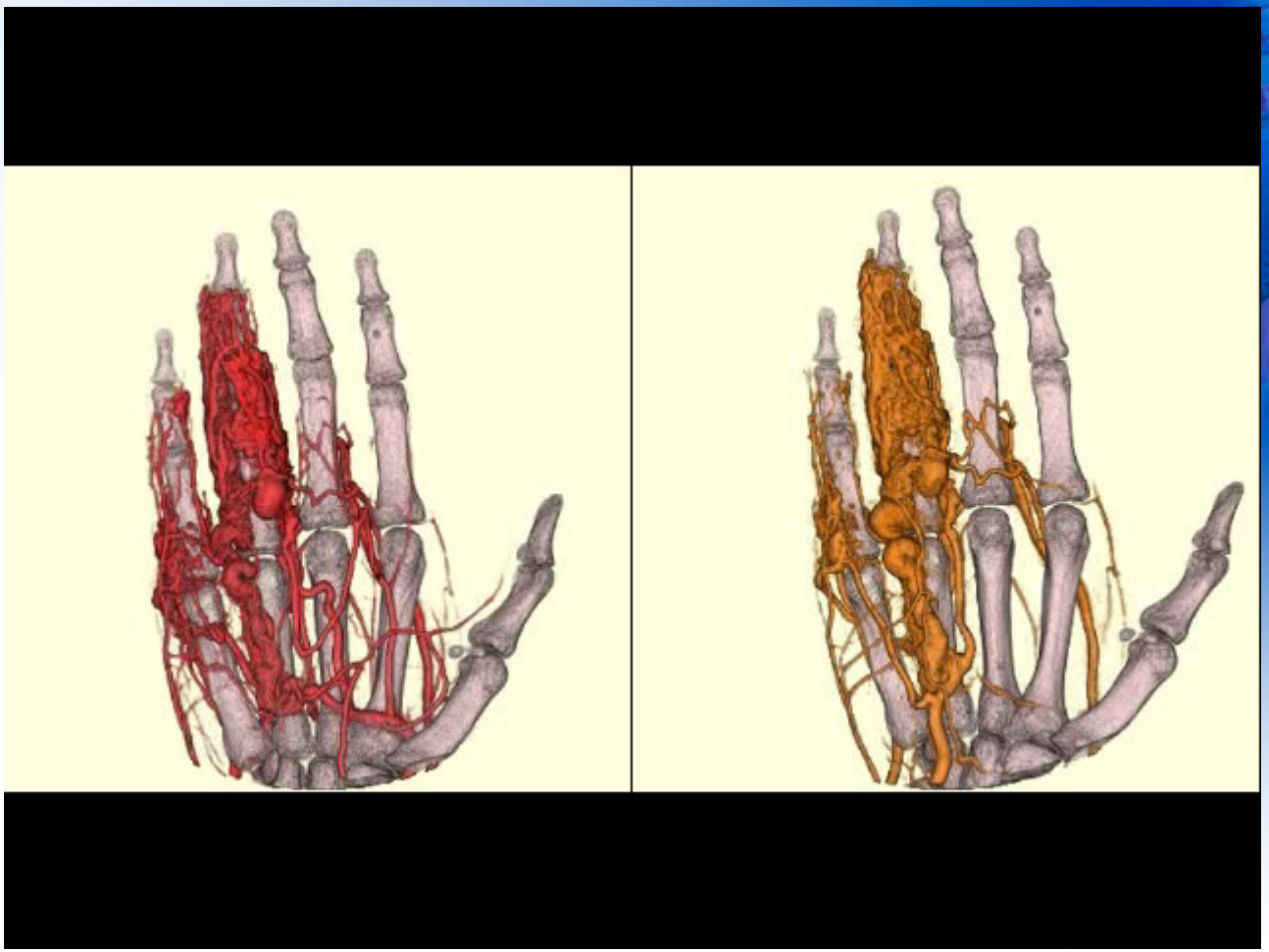


TOSHIBA

Neue klinische Anwendungen

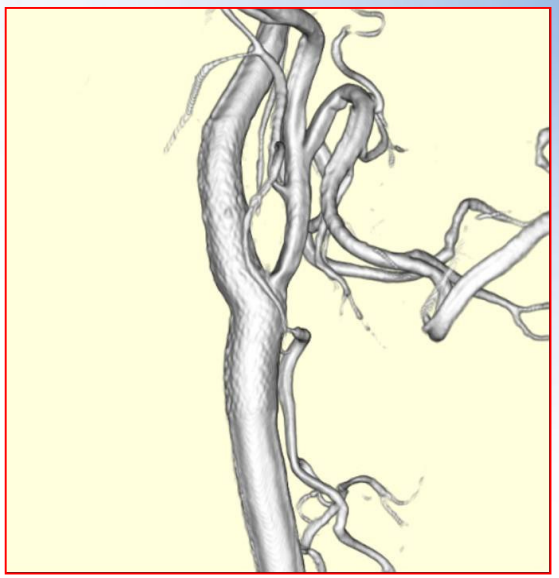


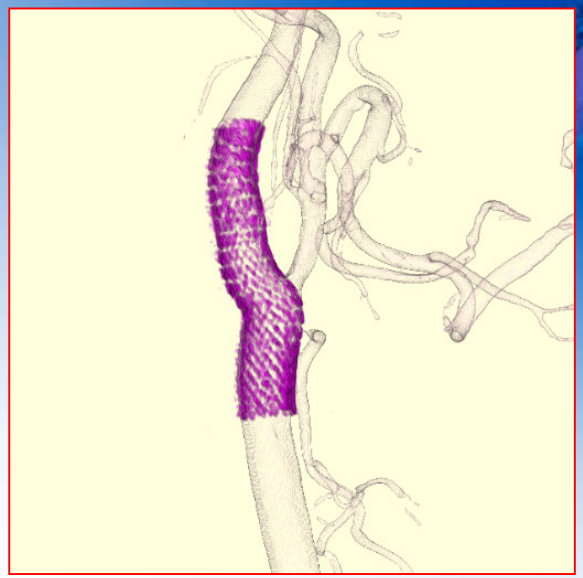
GEMEINSAM DAS RICHTIGE TUN



3D ANGIO

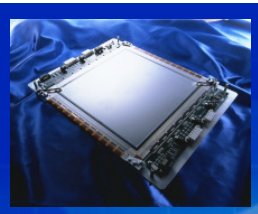
Stent-Fusion IMAGING





TOSHIBA

Neue klinische Anwendungen



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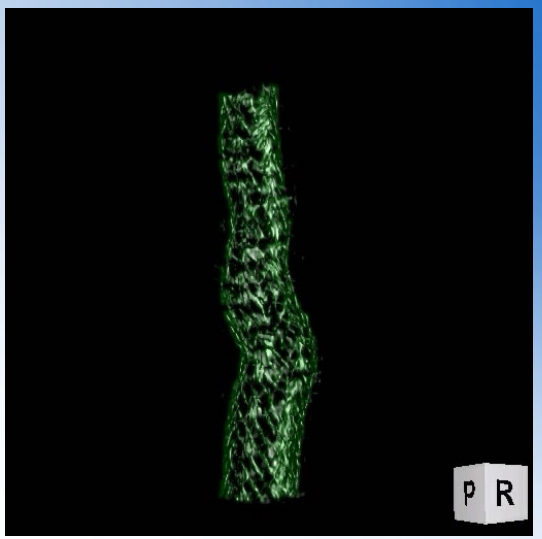
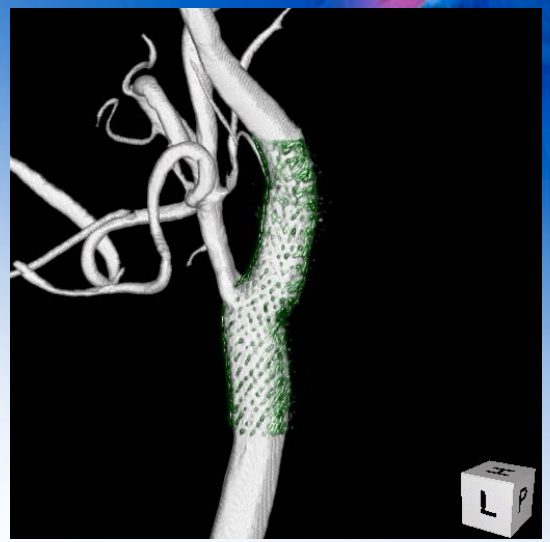
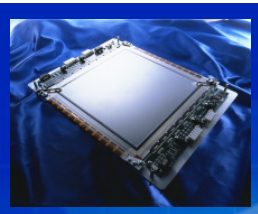




TOSHIBA

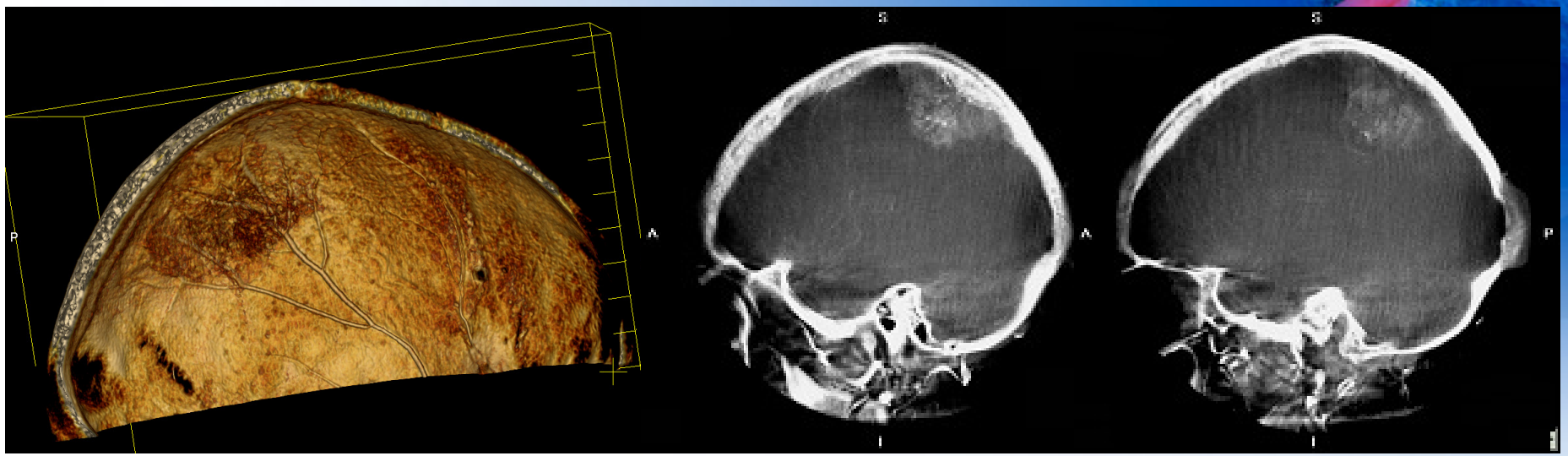
Neue klinische Anwendungen



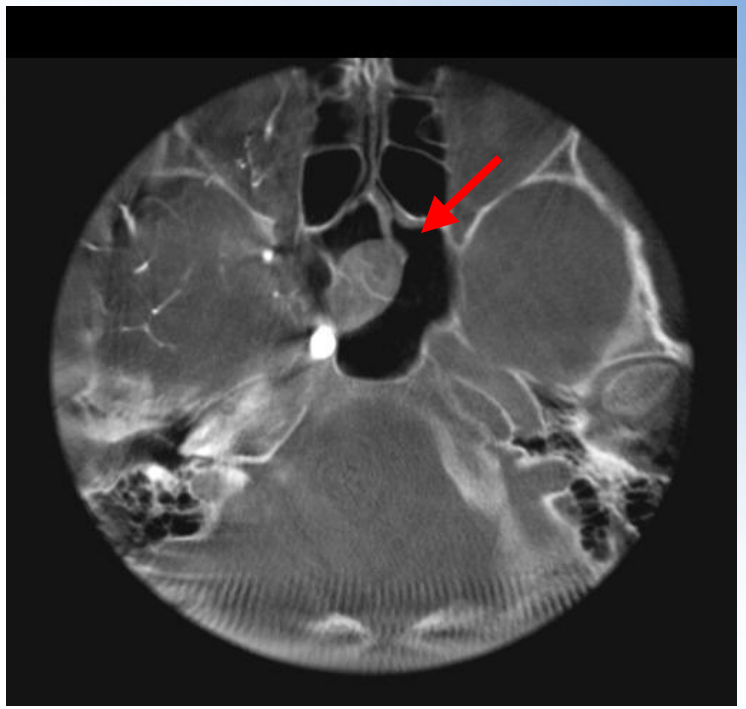
GEMEINSAM DAS RICHTIGE TUN

3D ANGIO

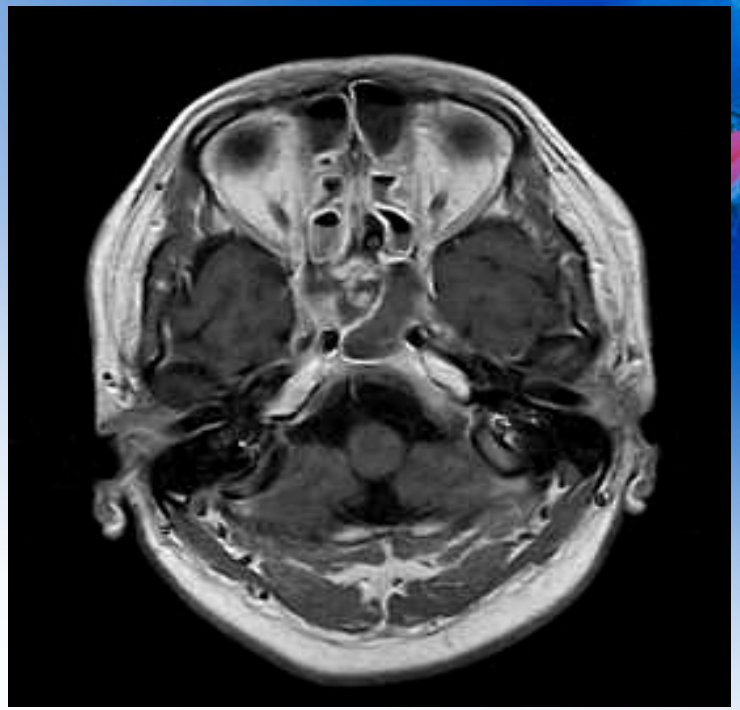
MPR-SureView IMAGING



MPR-SureView in 5 sec Rotational Scan

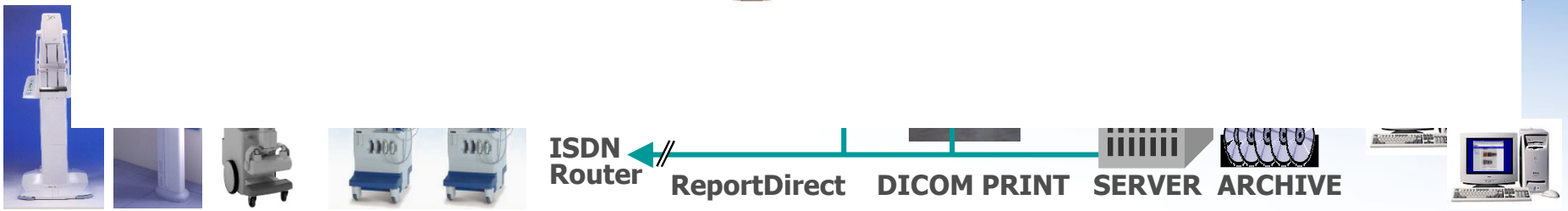


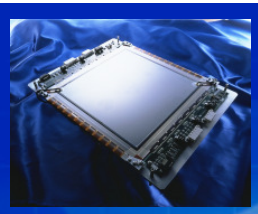
MPR-SureView



MRI（T1wi-Gd)

TOSHIBA



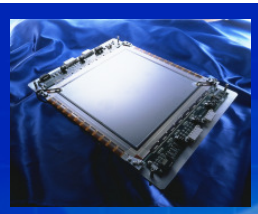


FPD IMAGING – VORTEILE

- 100% HALBLEITER TECHNOLOGIE (KEINE ...)
- KONSTANTE PERFORMANCE ÜBER DIE NUTZUNGSZEIT
- DIREKTE DIGITALE BILDAKQUISITION
- GRÖSSERER DYNAMISCHER BEREICH
- VERBESSERTE DETAILAUFLÖSUNG
- KEINE BILDDISTORTION (VERGLEICHEN MIT BV)
- DEUTLICHE REDUKTION DER STRAHLENDOSIS
- SCHLANKERES GERÄTEDESIGN
- VERBESSERTER PATIENTENZUGANG

TOSHIBA

Schlußfolgerung

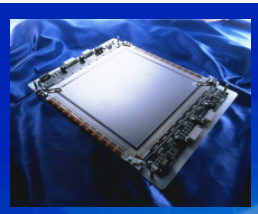


GEMEINSAM DAS RICHTIGE TUN

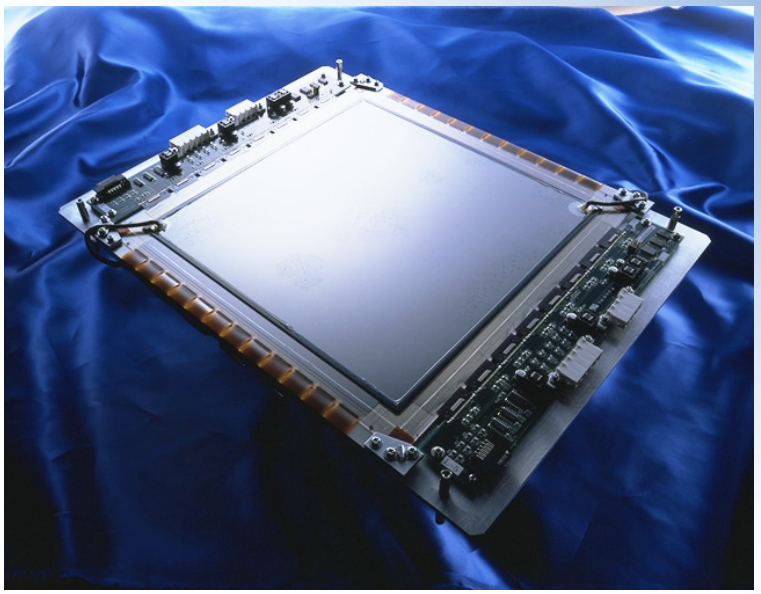
Digitale dynamische Festkörperdetektoren sind konventionellen Bildverstärkern bezüglich der Kontrast-Detail-Erkennung, Auflösung und Dosis deutlich überlegen.

Und damit ein Gewinn für die diagnostische Sicherheit.

TOSHIBA



GEMEINSAM DAS RICHTIGE TUN



Vielen Dank für

Ihre Aufmerksamkeit