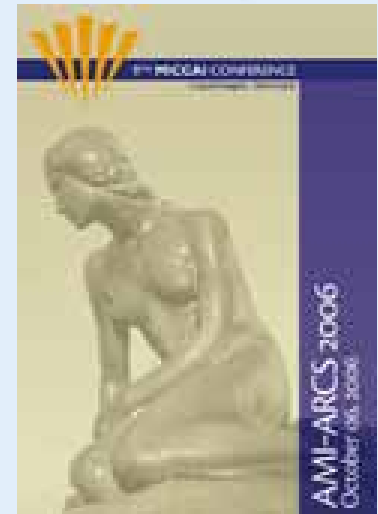


Augmented Environments

—

A Surgeon's Viewpoint

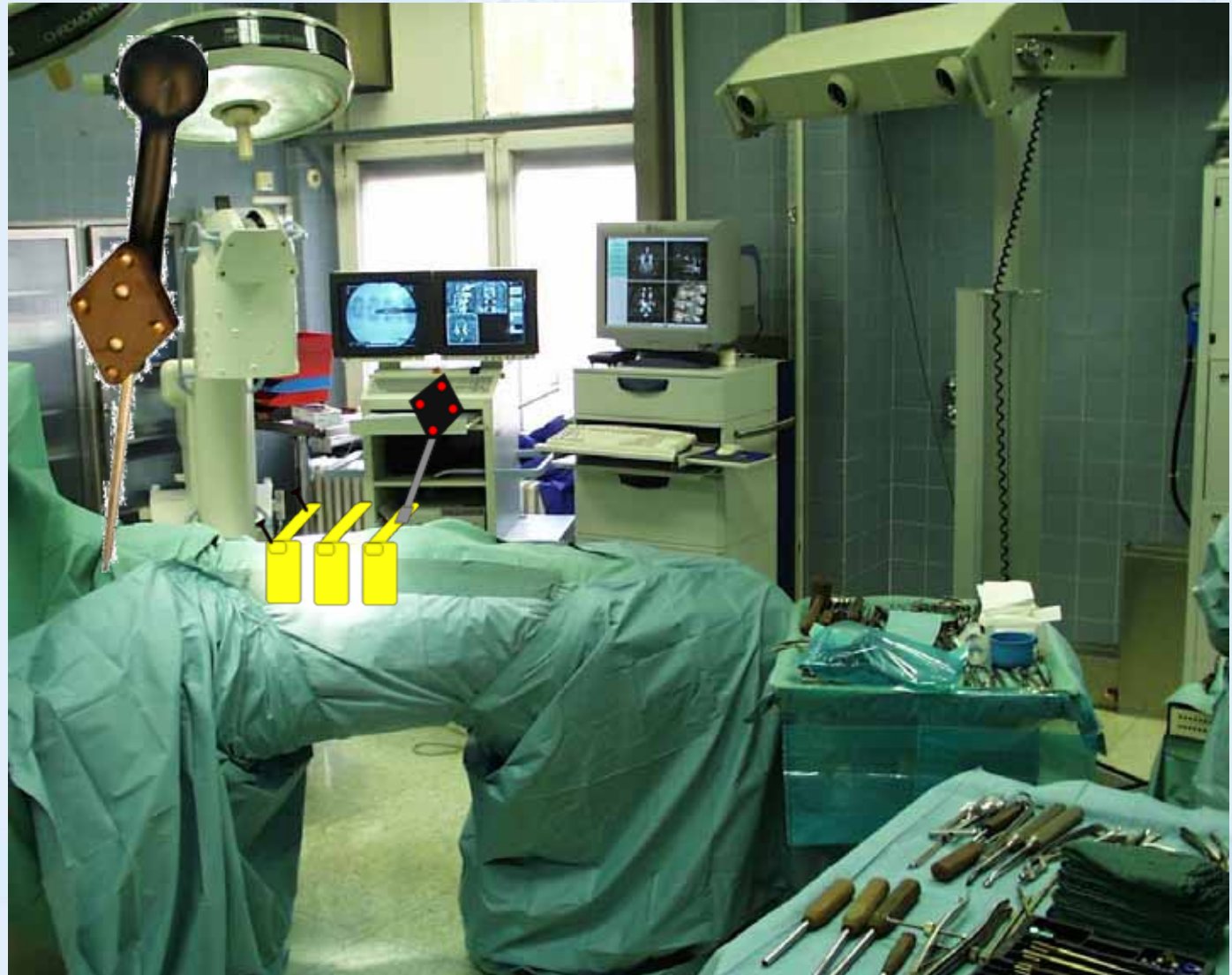
Sandro-Michael Heining



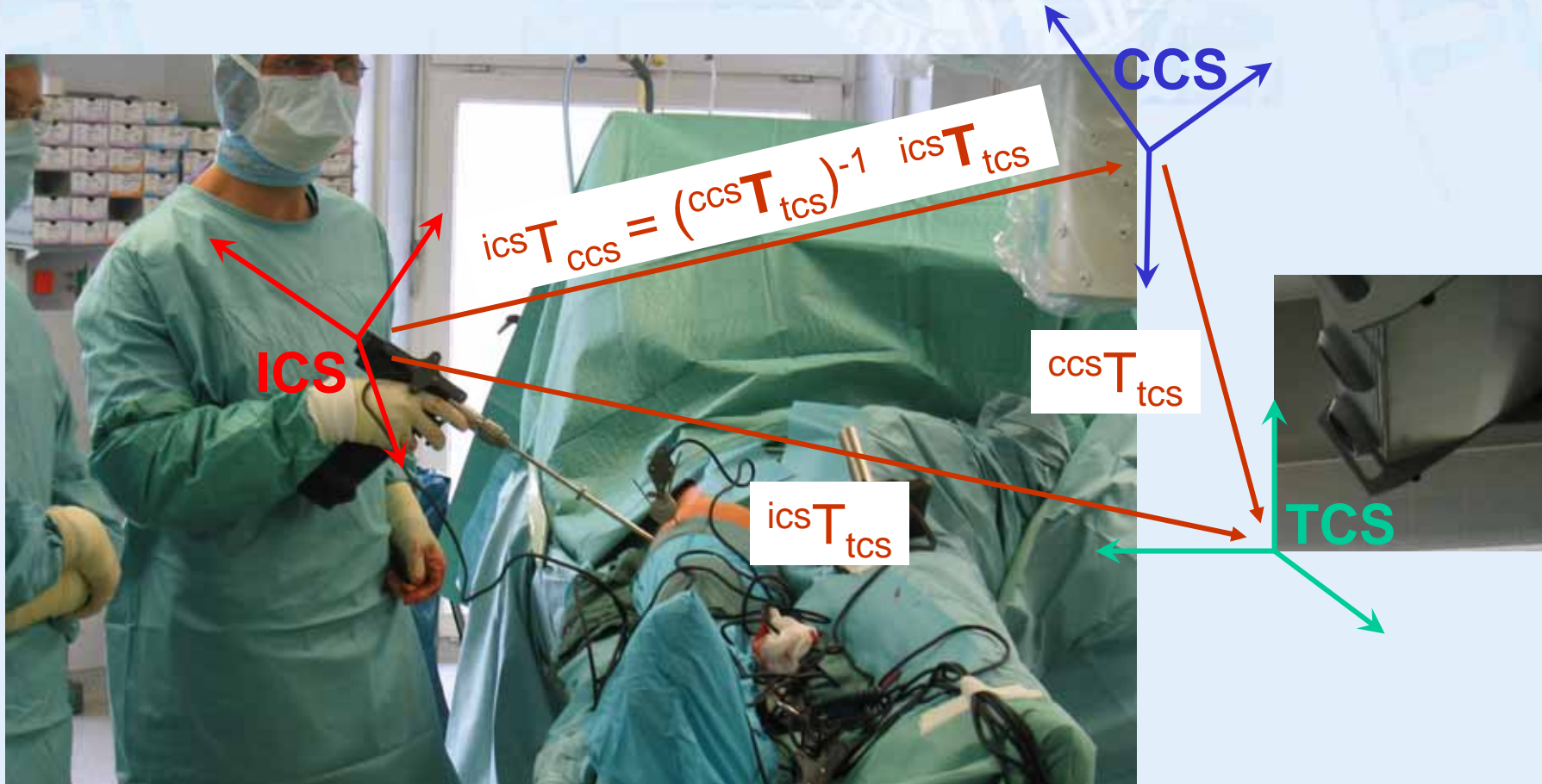


“hype cycles of innovation” by Gartner Group in: Technology Review - MIT´s Magazine of Innovation 10/2006

since 2001 intraoperative 3D-imaging:
Iso-C-3D + Medivision



registrationfree surgical navigation



$$p_{2D} = P \ ccsT_{ocs} \ (ccsT_{tcs})^{-1} \ icsT_{tcs} \ mcsT_{ics} \ p_{3D}$$

IMAGE 40
SER 1-4



16:22
09-MAR-2004
IMAGE 10
SER 1-2



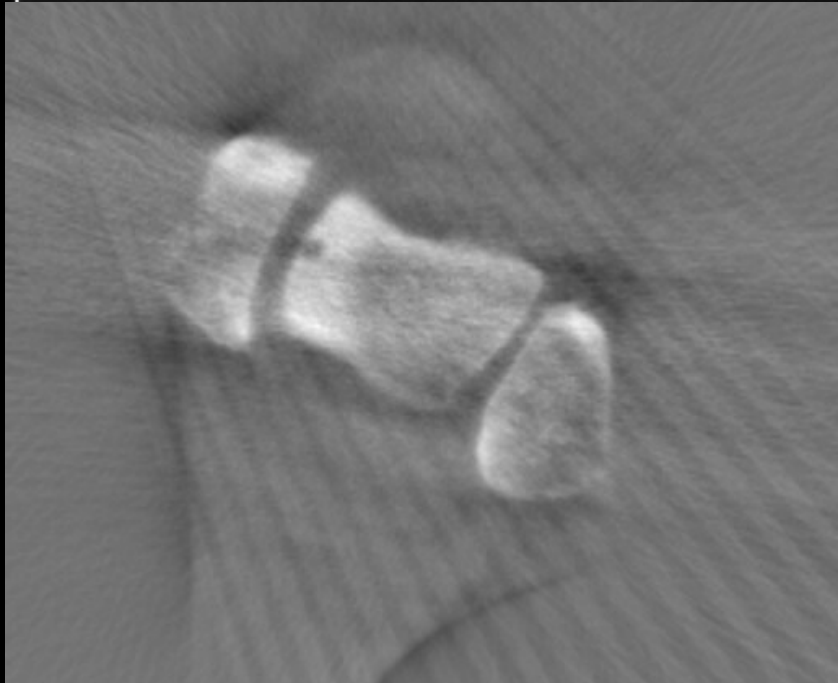
tir1_11m180
*R 140
1 SAT
TR 5027.0

SP -48.9
SL 3.0
FoV 175*200
187 *2560

16:25
09-MAR-2004
IMAGE 26
SER 1-3



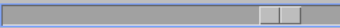
SP -48.9
SL 3.0
FoV 175*200
256h*5120



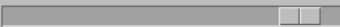
- Patient Data
- Planning Section
- Alignment
- Tools

- Verification
- Realtime
- Guidance

Brightness

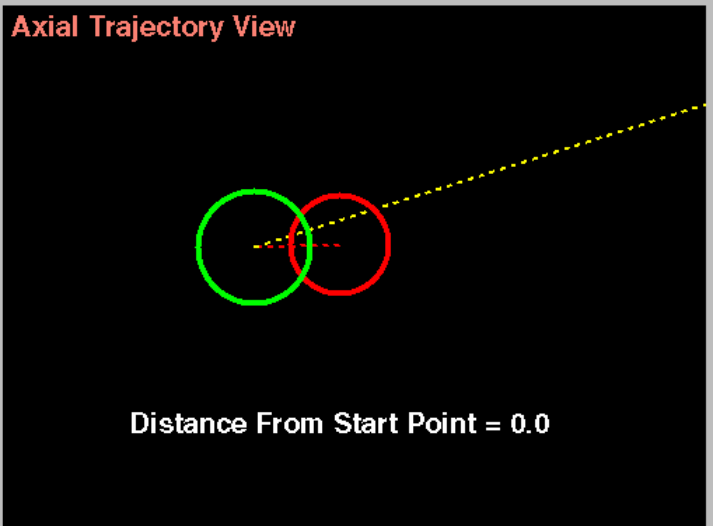
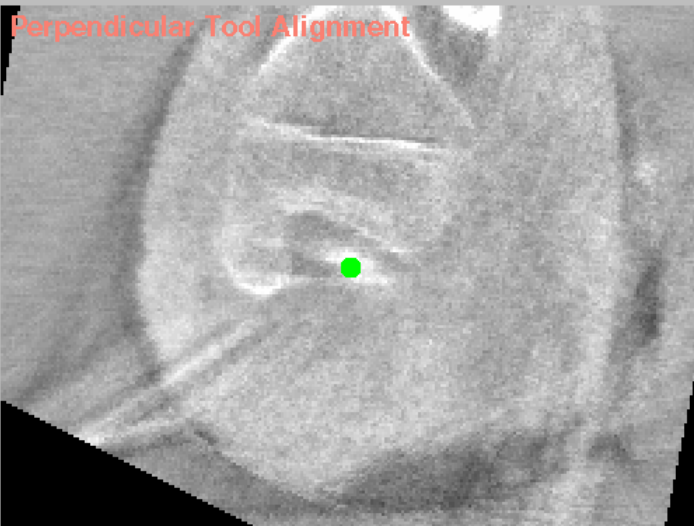
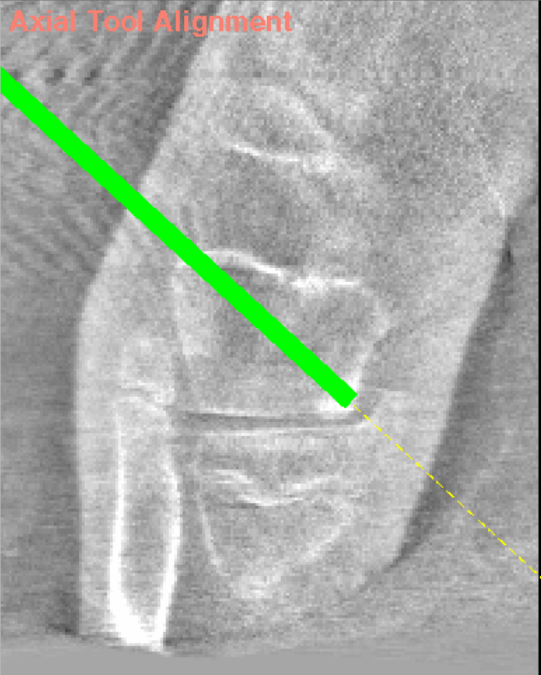


Contrast



Manual Matching

Trajectory Set





LMU Chirurgie Innenstadt

PAPIN,ROBERT
1978.12.23
2004.08.17
15:00:00
IM:10
SE:3

S100

R
1
9
4

L
1
8
5

T1 cor chir.
W 1144 : L 529

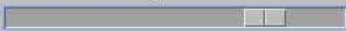
I164

SL:4
-8.908
FLIP:180
CONTRAST:
TR:560
TE:14

- Patient Data**
- Planning Section**
- Alignment**
- Tools**

- Verification**
- Realtime**
- Guidance**

Brightness

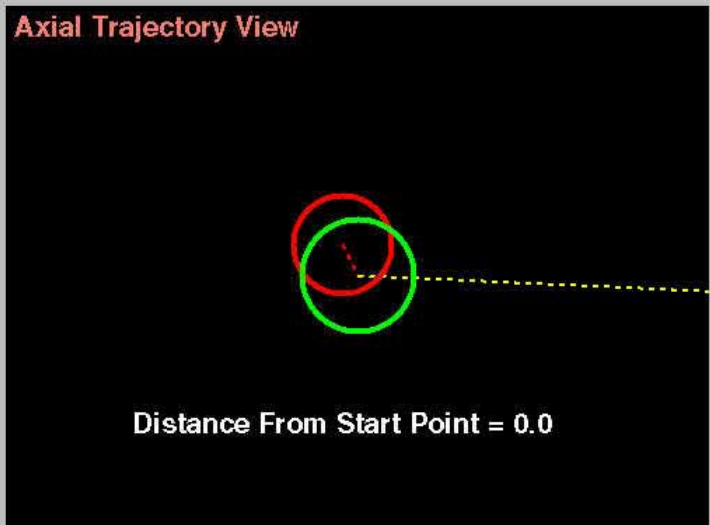
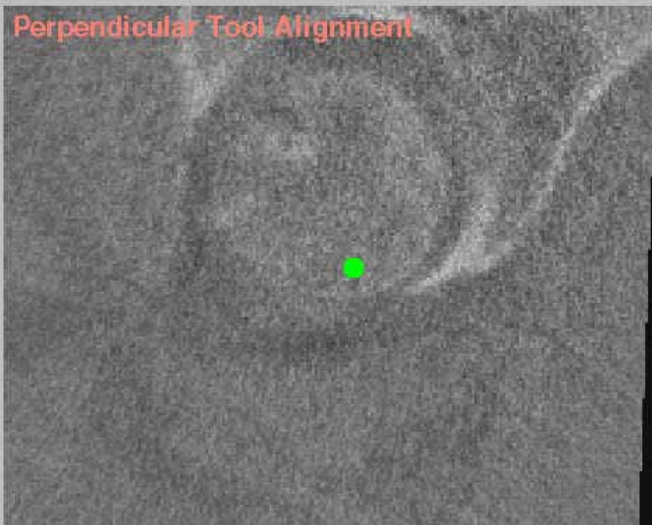
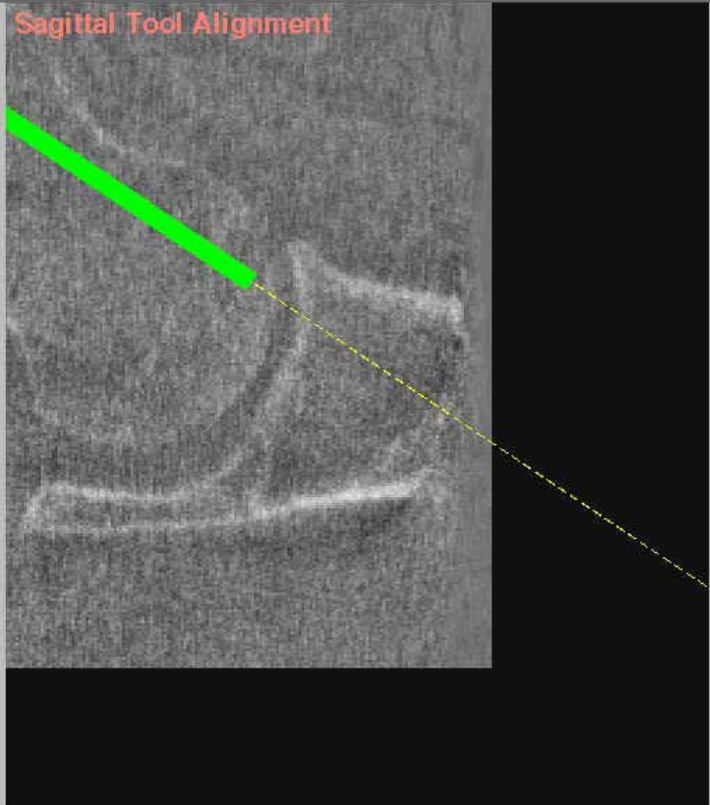


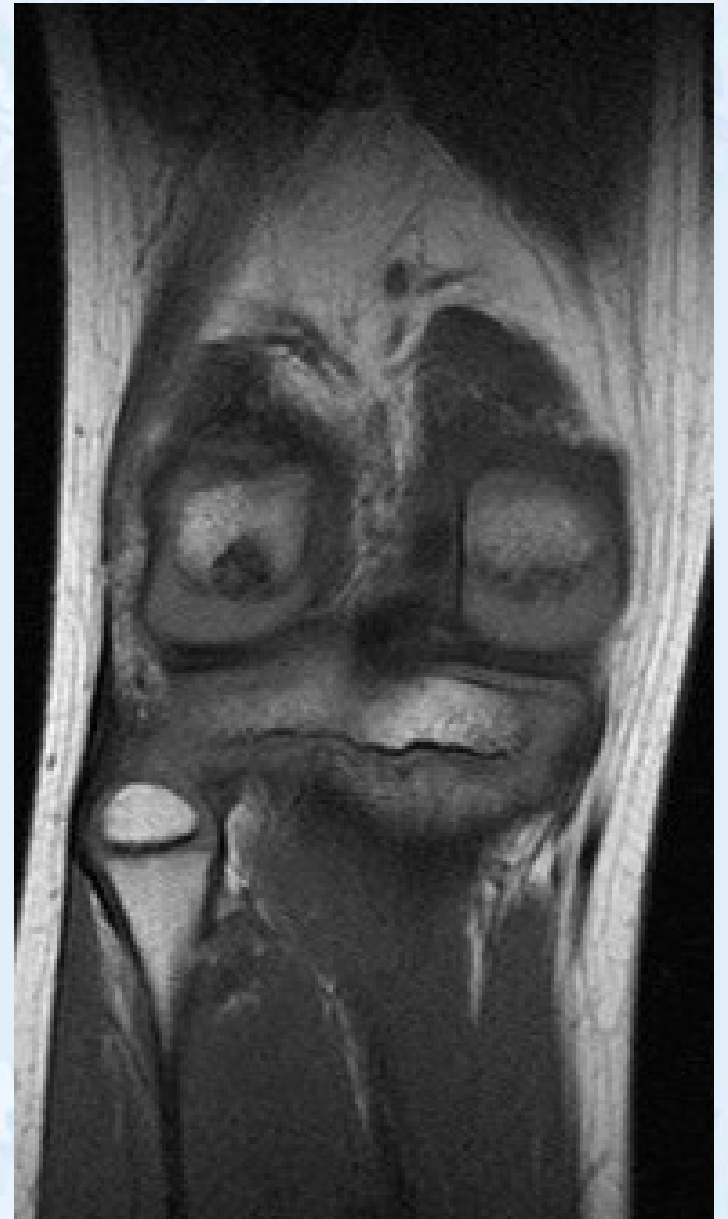
Contrast



Manual Matching

Trajectory Set

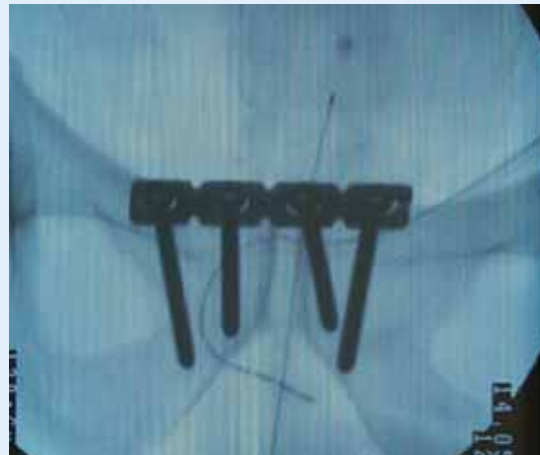
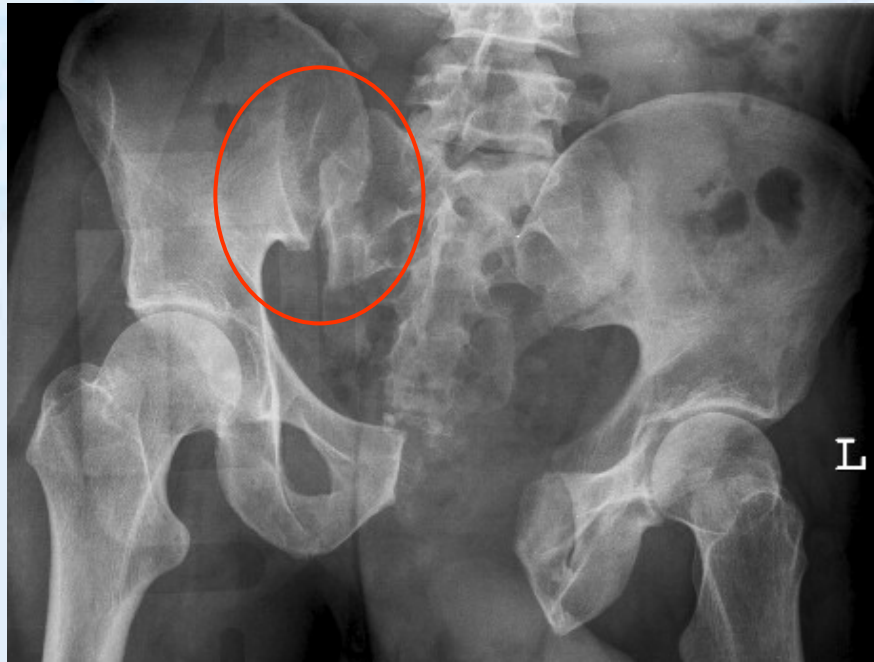








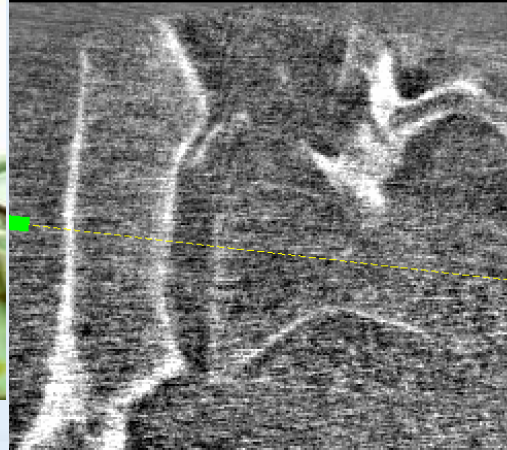
3 D Navigation: SI Screws



3 D Navigation: SI Screws



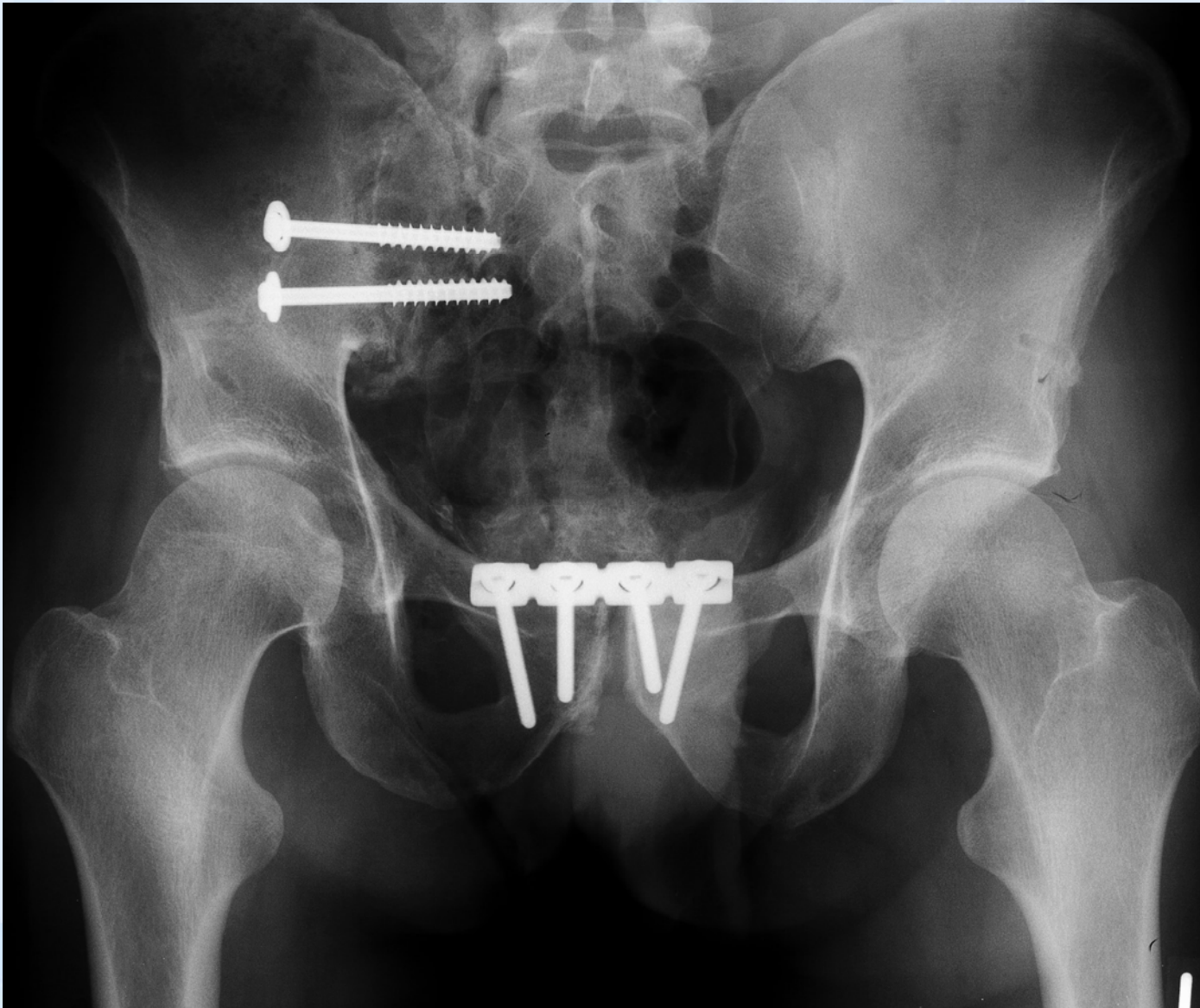
Axial Tool Alignment



Sagittal Tool Alignment





3 D Navigation: SI Screws



User interfaces

- Patient
- Pre-Op
- Tools
- Matching
- Realtime
- Guidance
- Image Tool
- 3D Segmentation
- Landmarks
- Trajectories

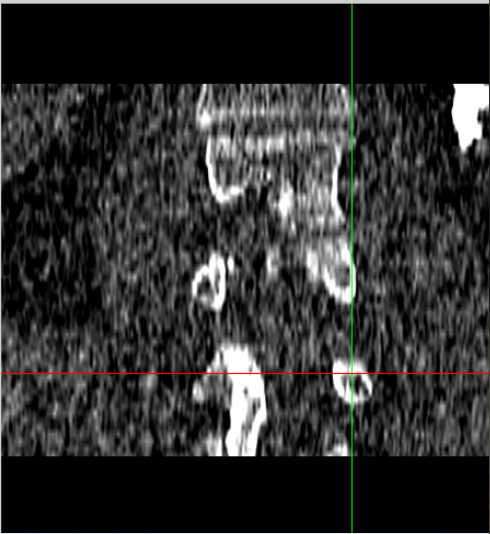
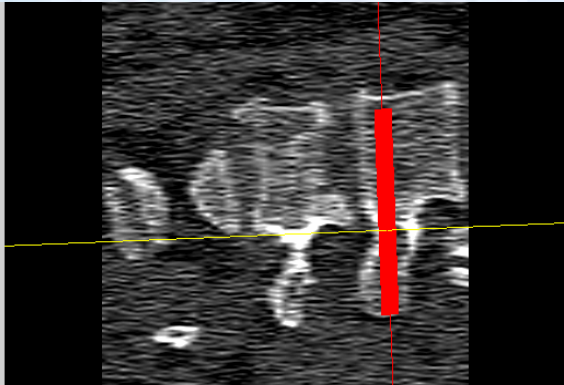
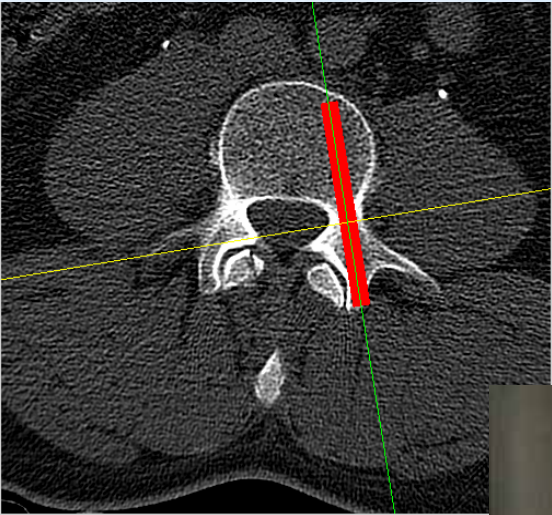
TJ #3  

Set Entry Point Set End Point

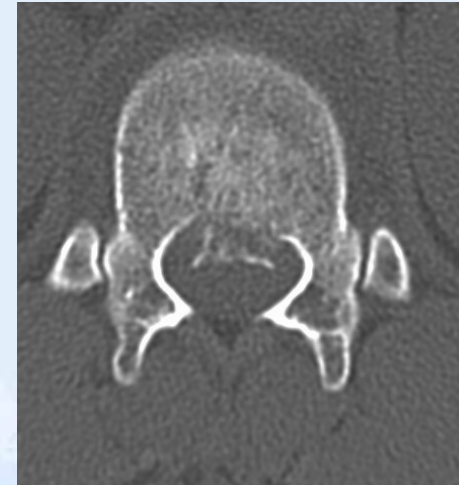
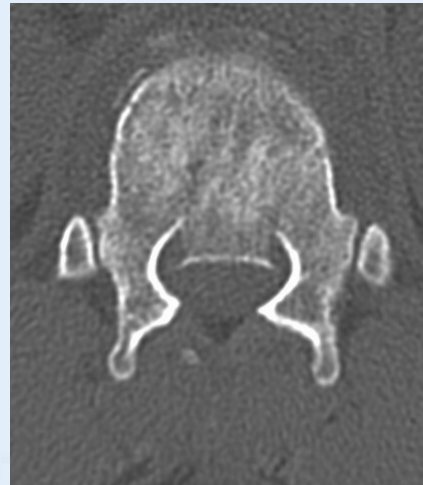
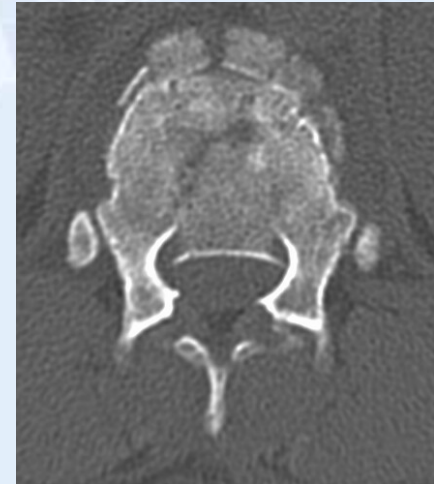
Draw Delete

41

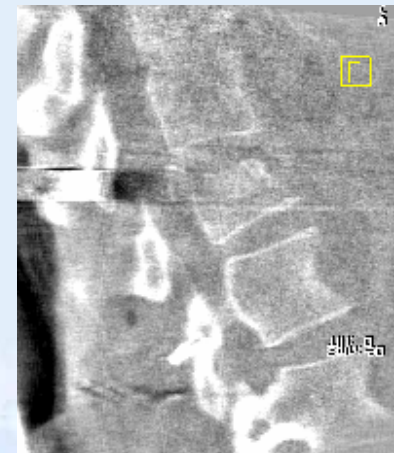
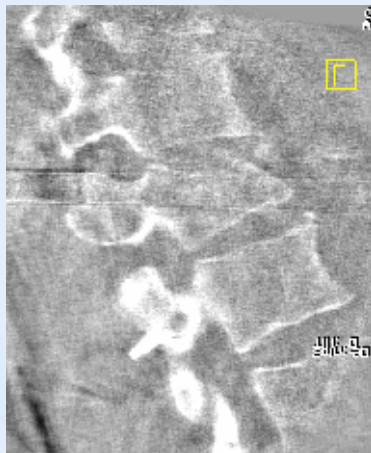
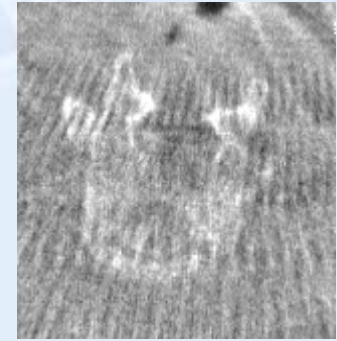
Trajectory Visualizer [%]



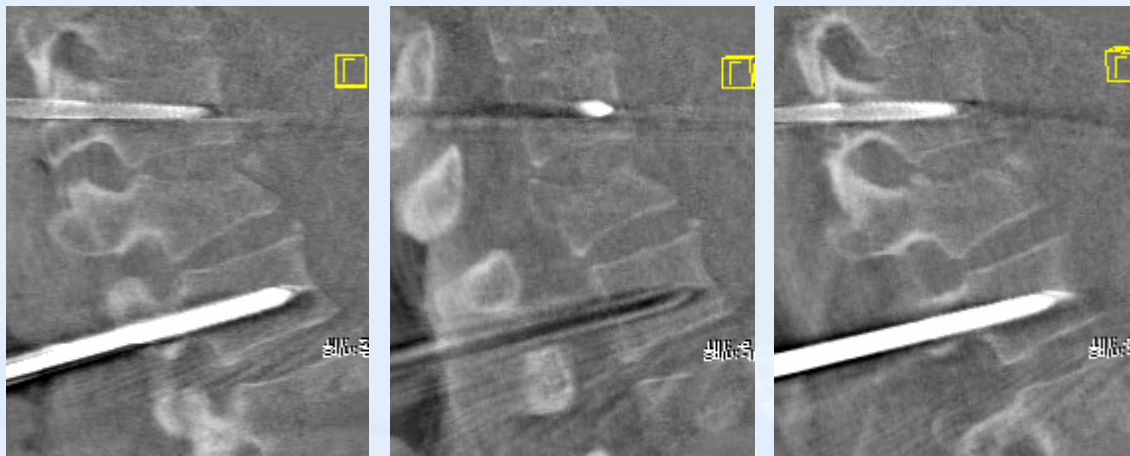
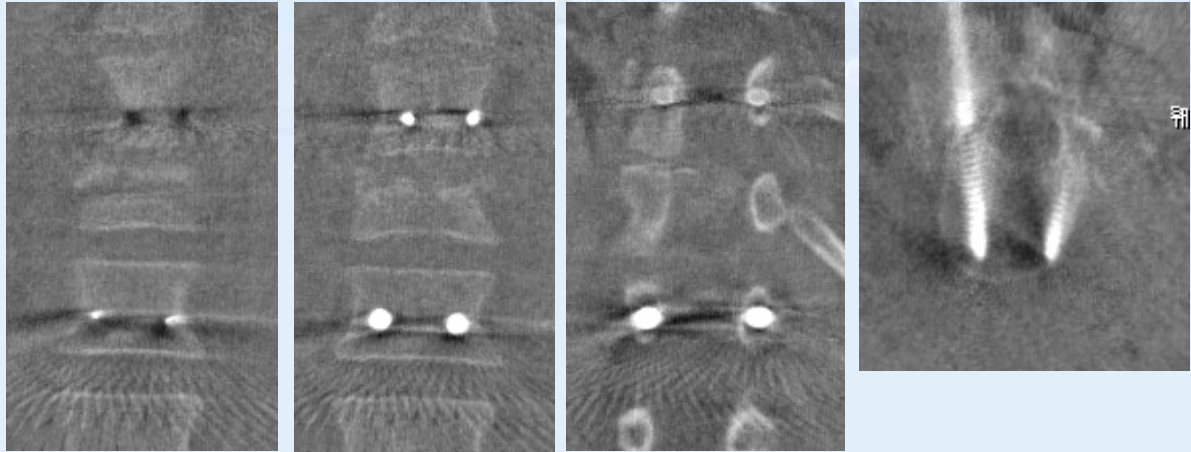
T12 burst fracture

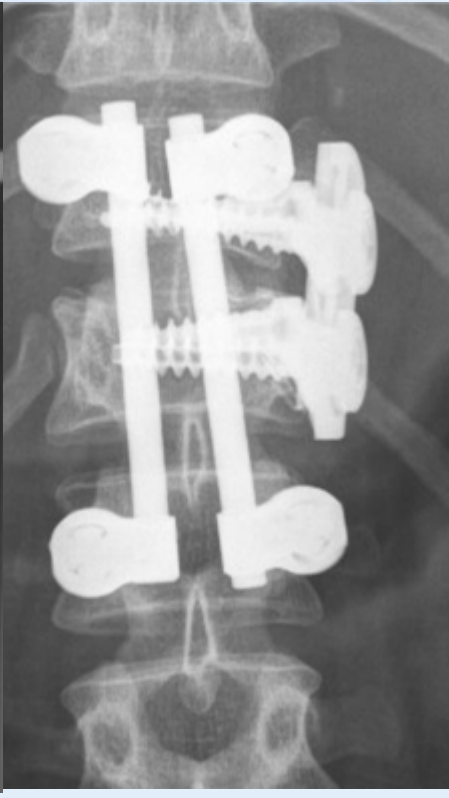
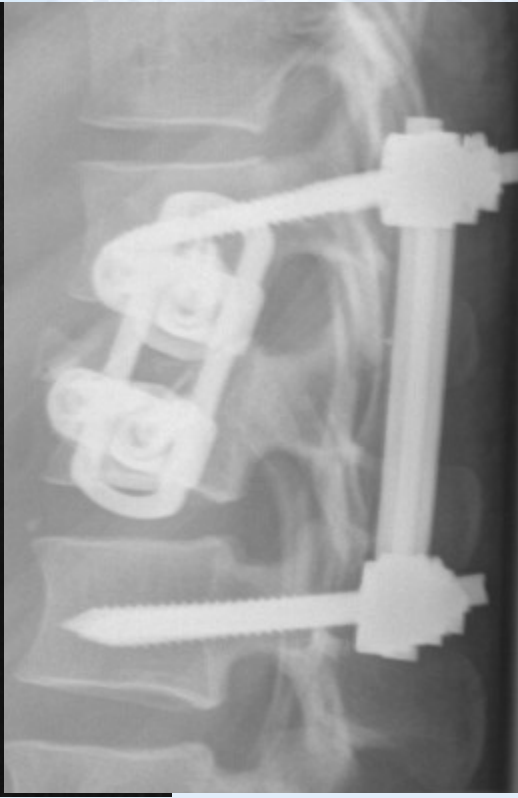


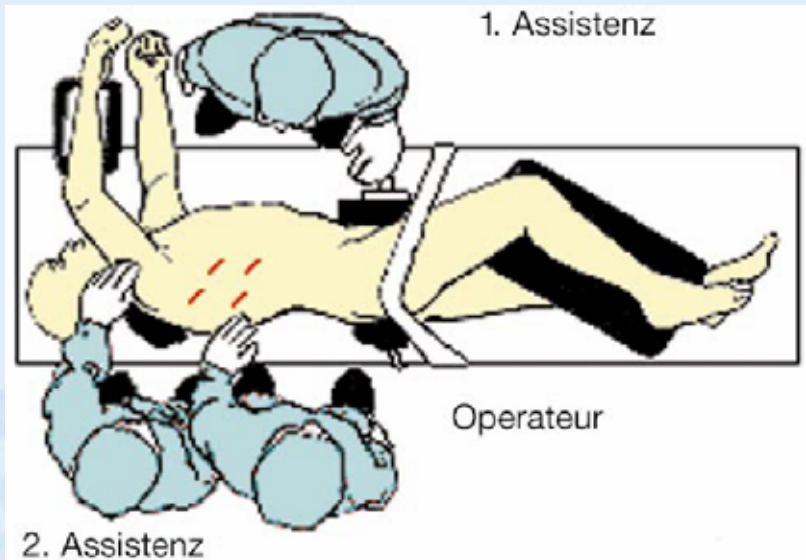
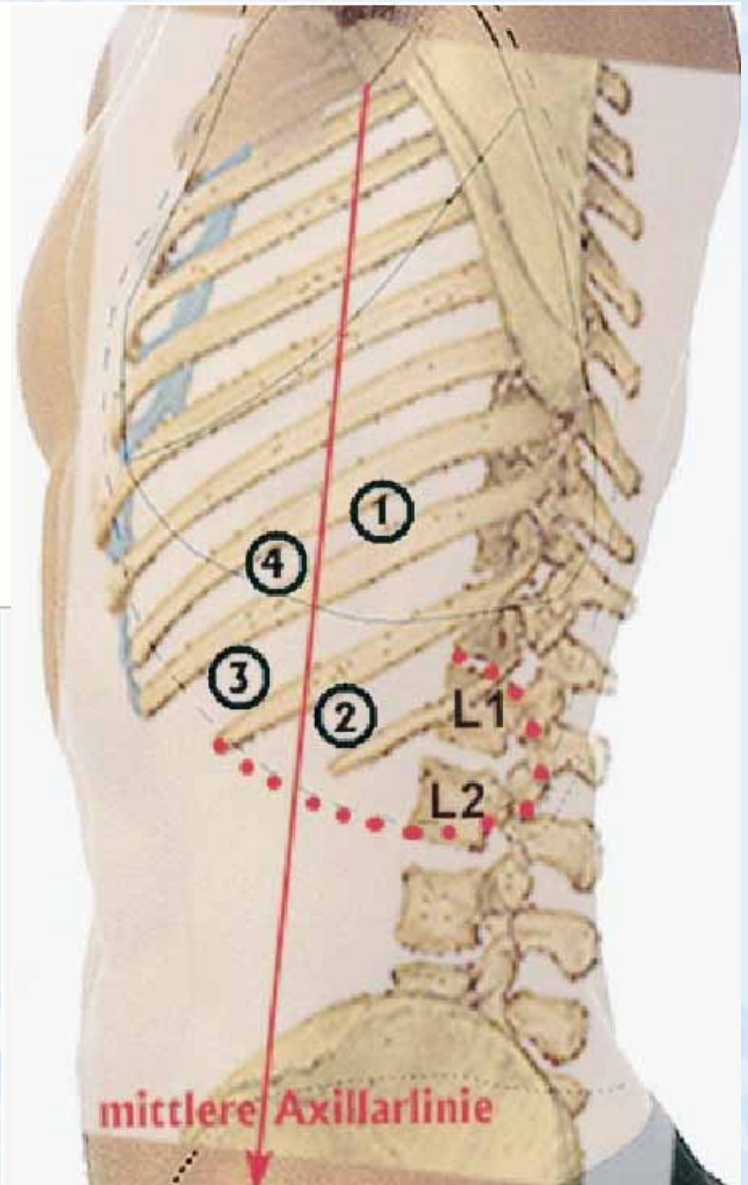
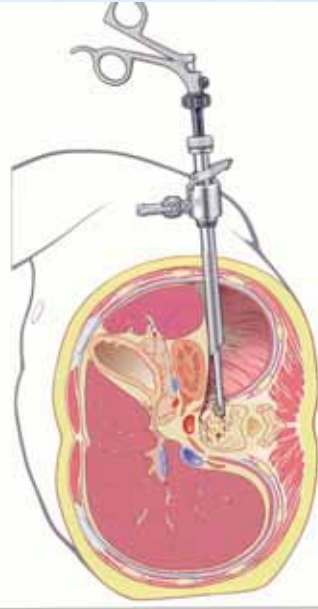








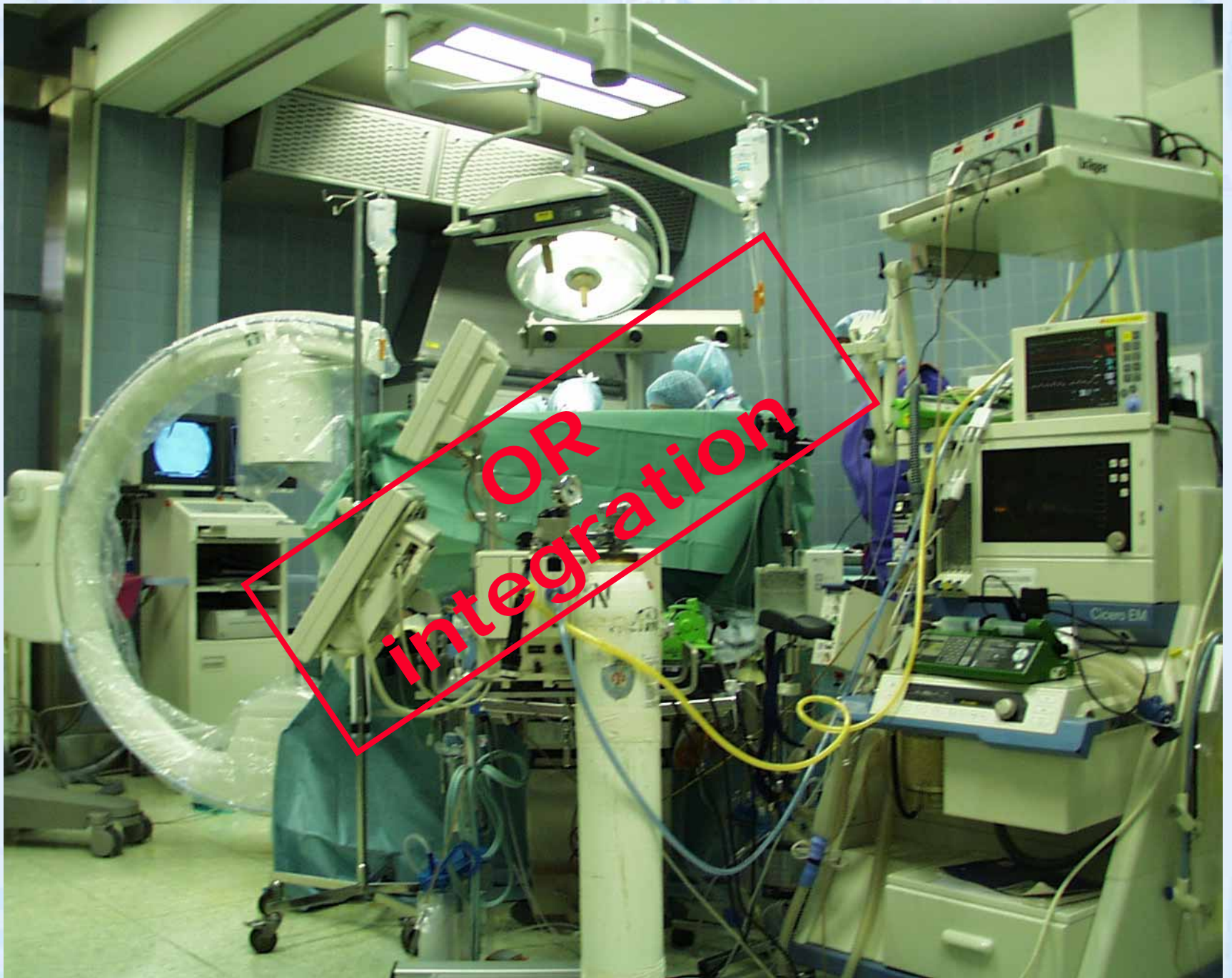


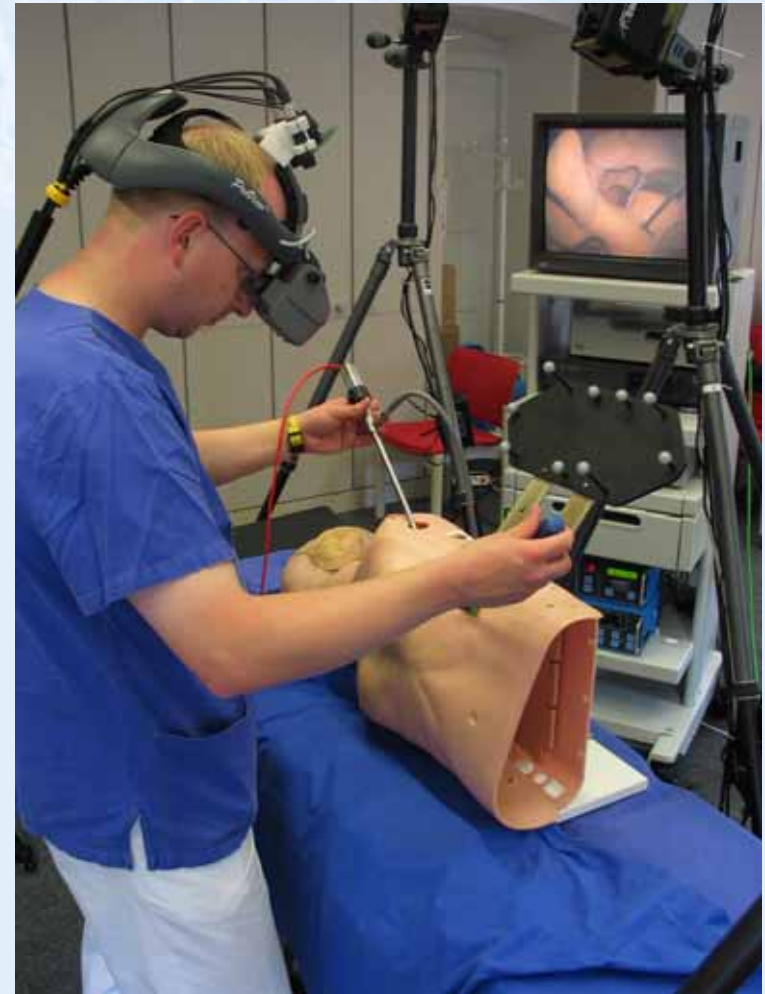


1. Assistenz

Operateur

2. Assistenz



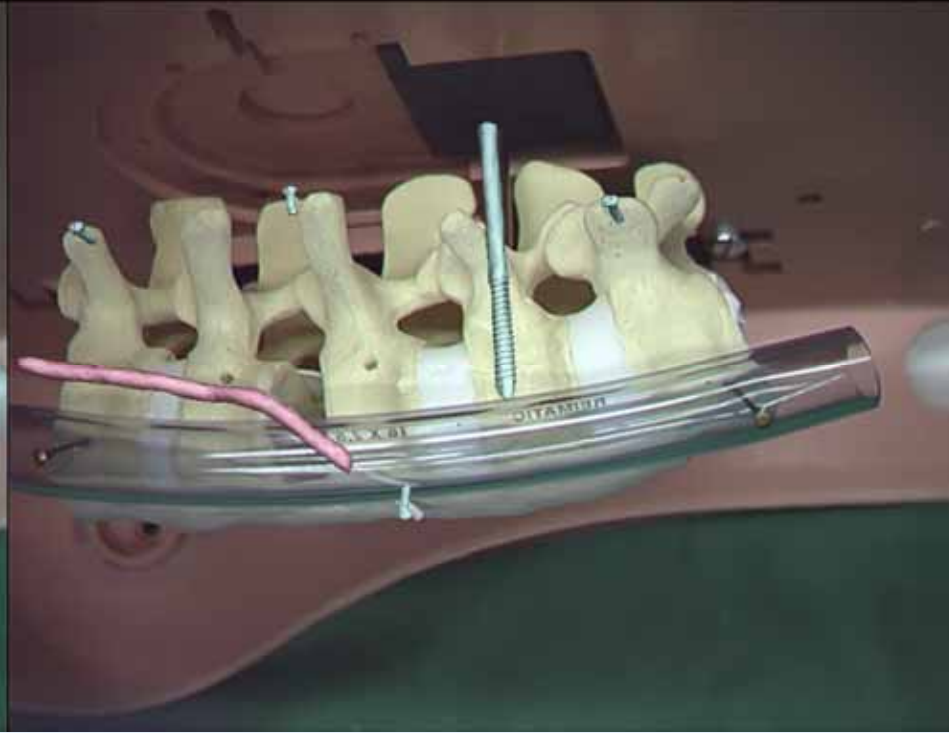
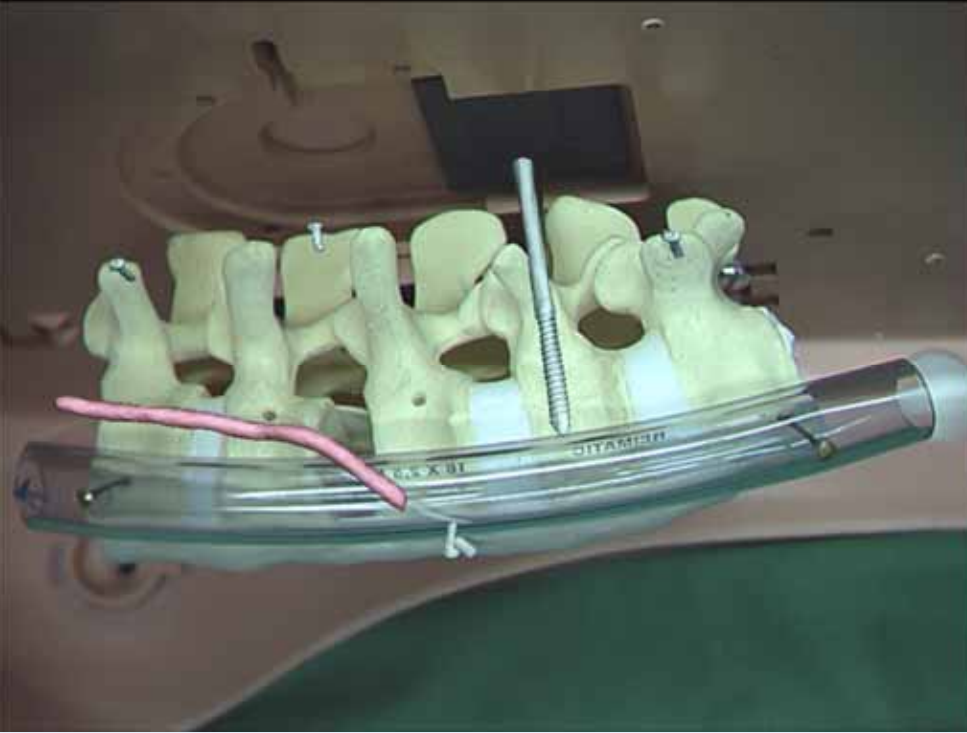


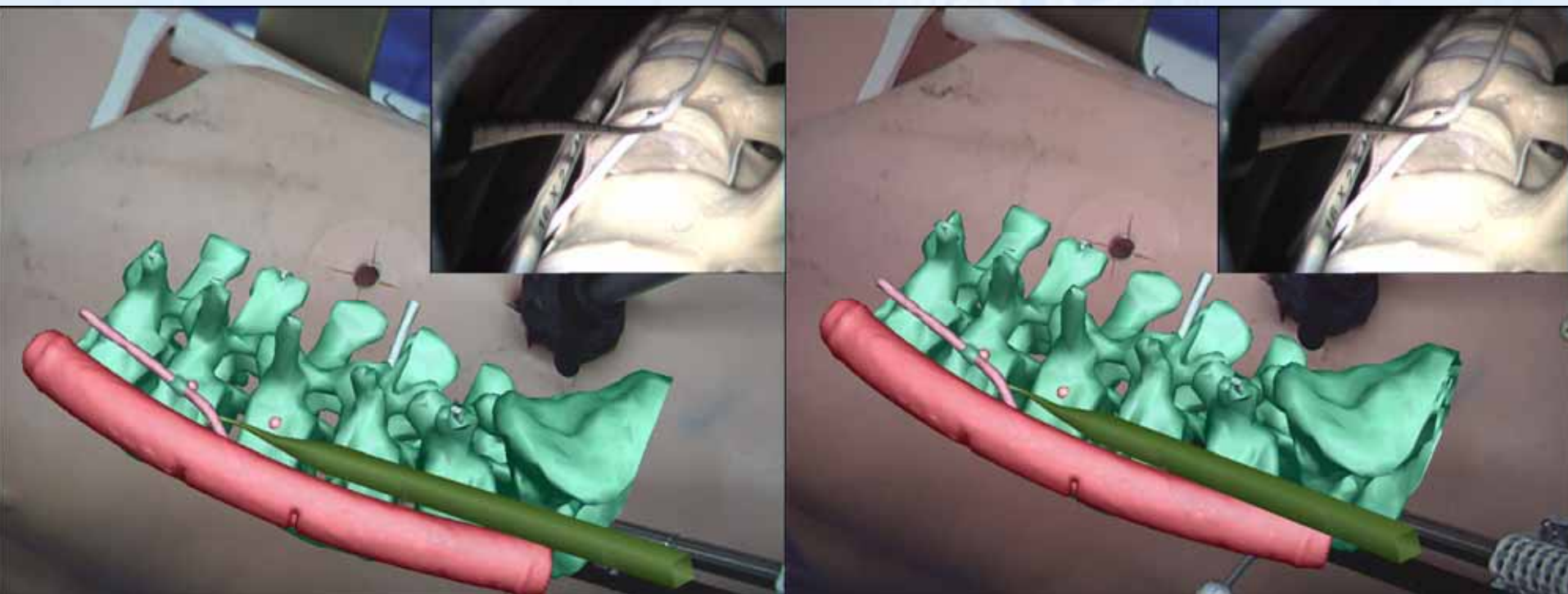
RAMP-System 08/2003:

Frank Sauer, Sebastian Vogt, Ali Khamene *SCR*

building spine phantoms

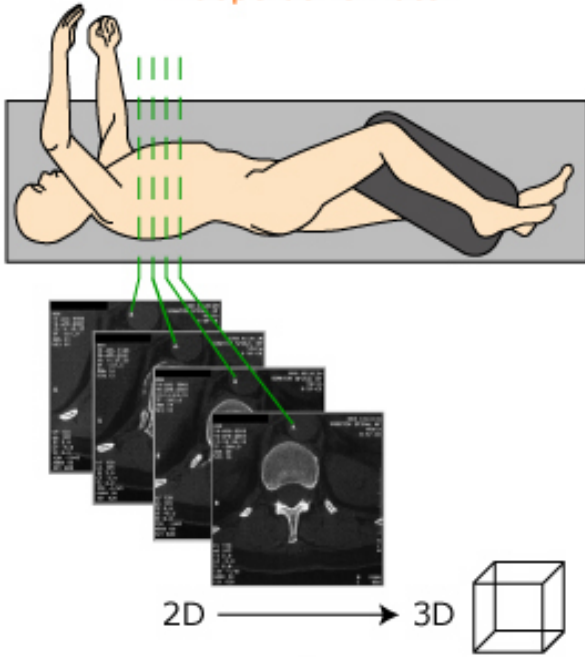








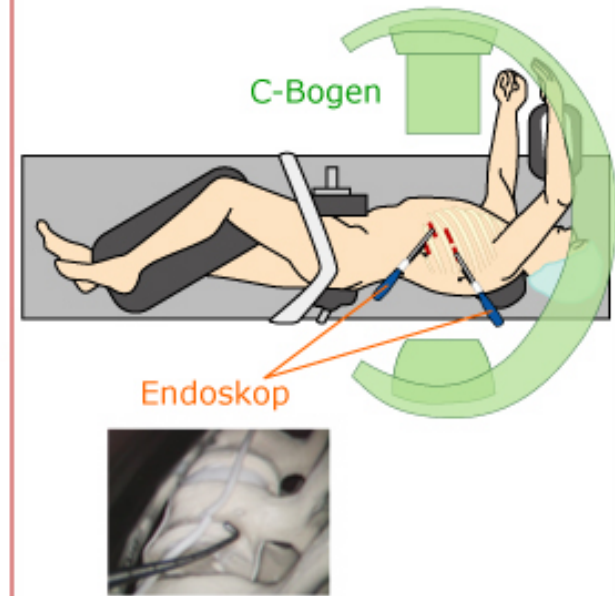
Präoperative Daten



Natürliche Sicht

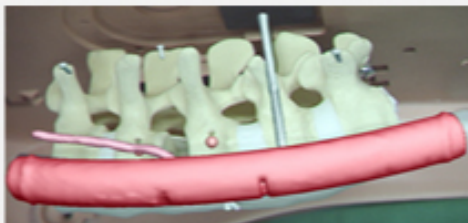


Intraoperative Bilddaten

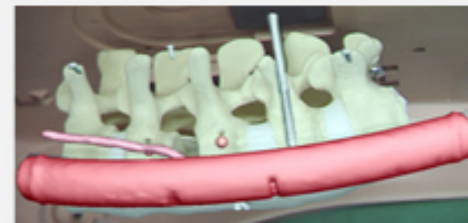


lagerichtige 3D-Datenfusion und Ausgabe auf dem **HMD**

für linkes Auge



für rechtes Auge



Augmented reality und in-situ-visualisation

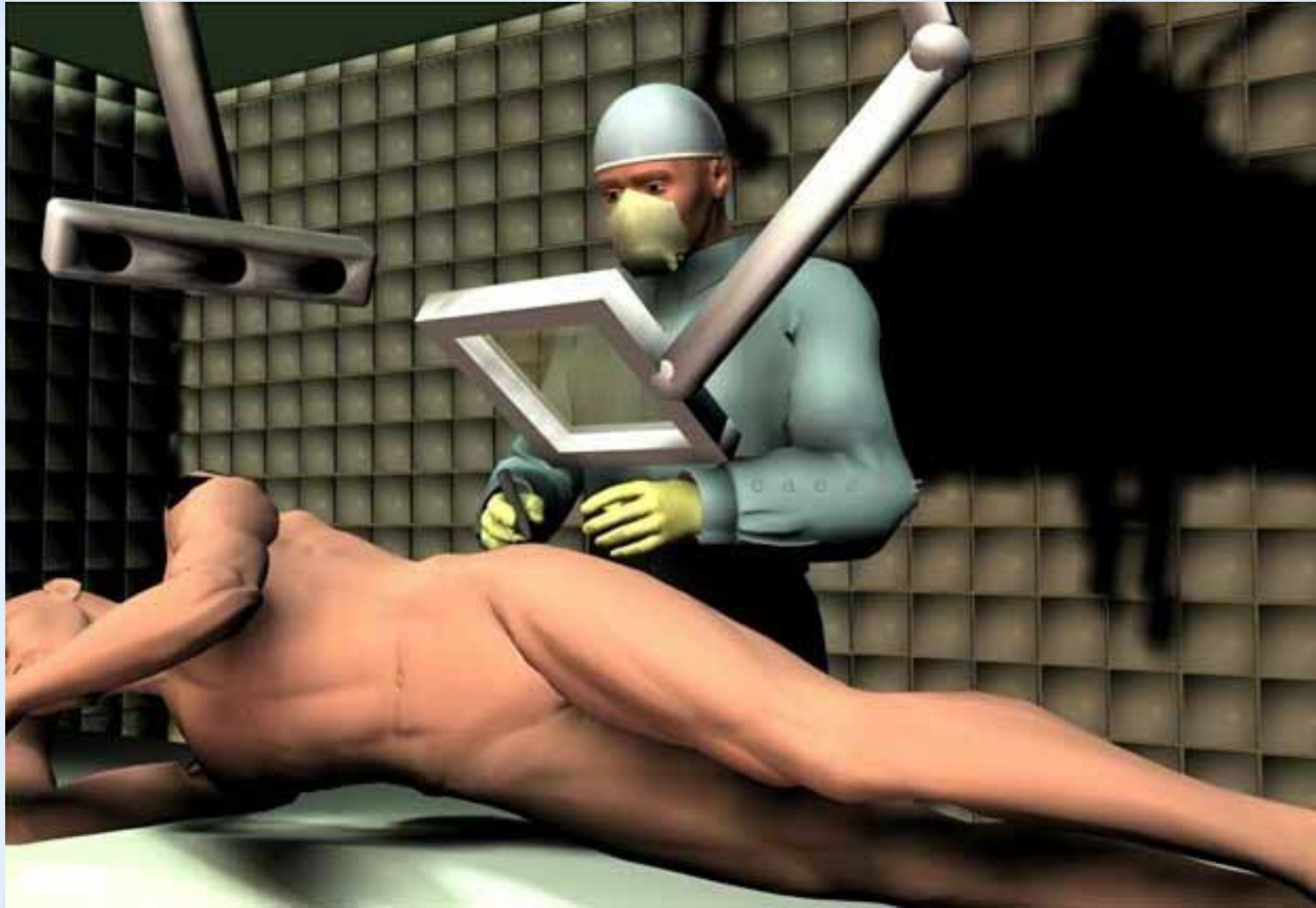
n@arvis



Bayerische
Forschungstiftung

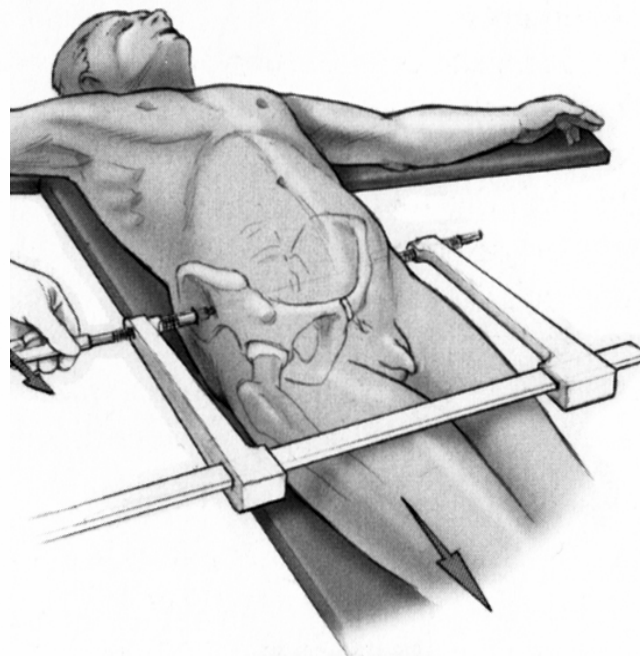
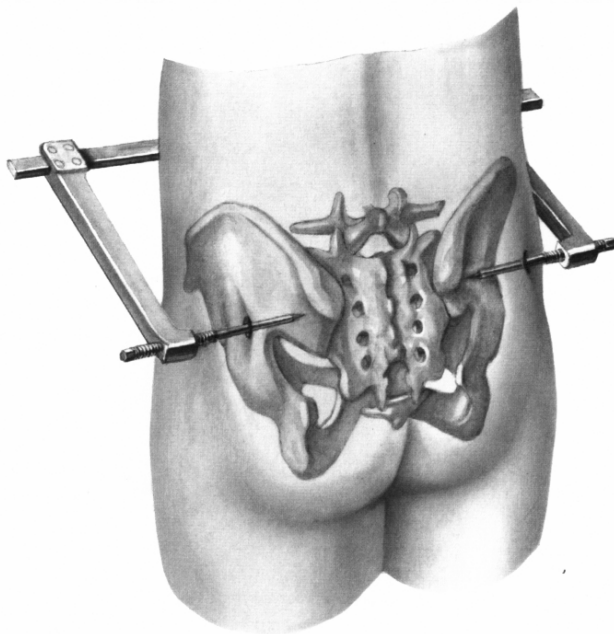
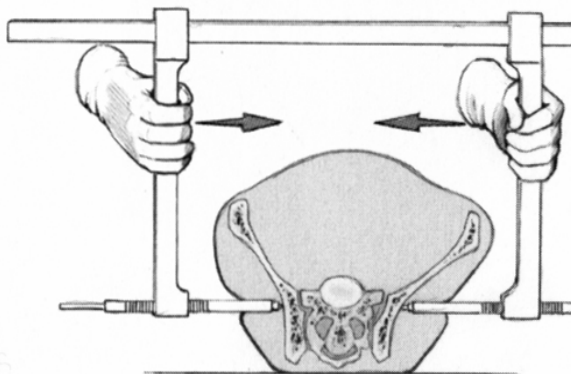


NARVIS 09/2004 – 09/2007



A. DiGioia, B. Jaramaz

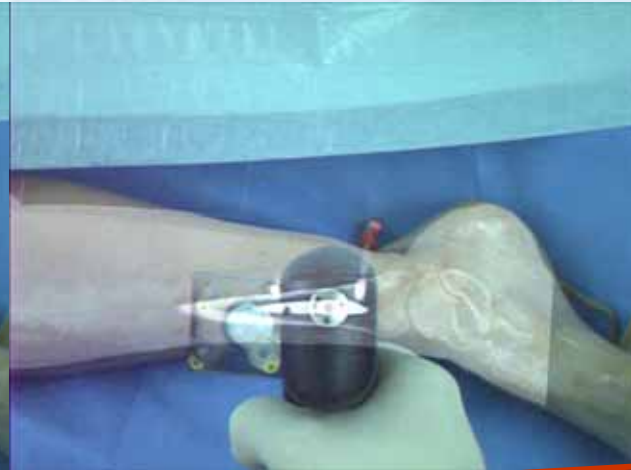
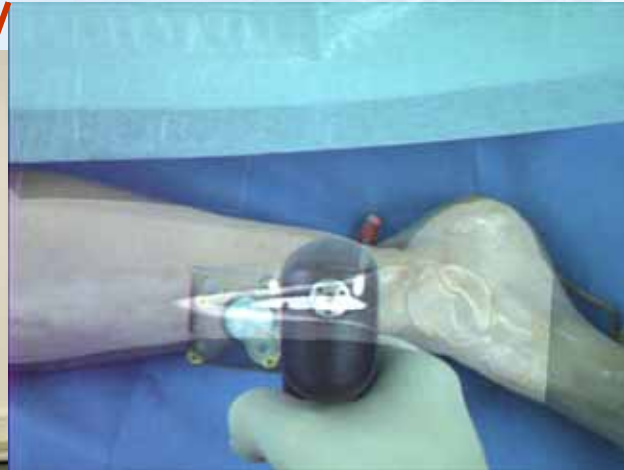
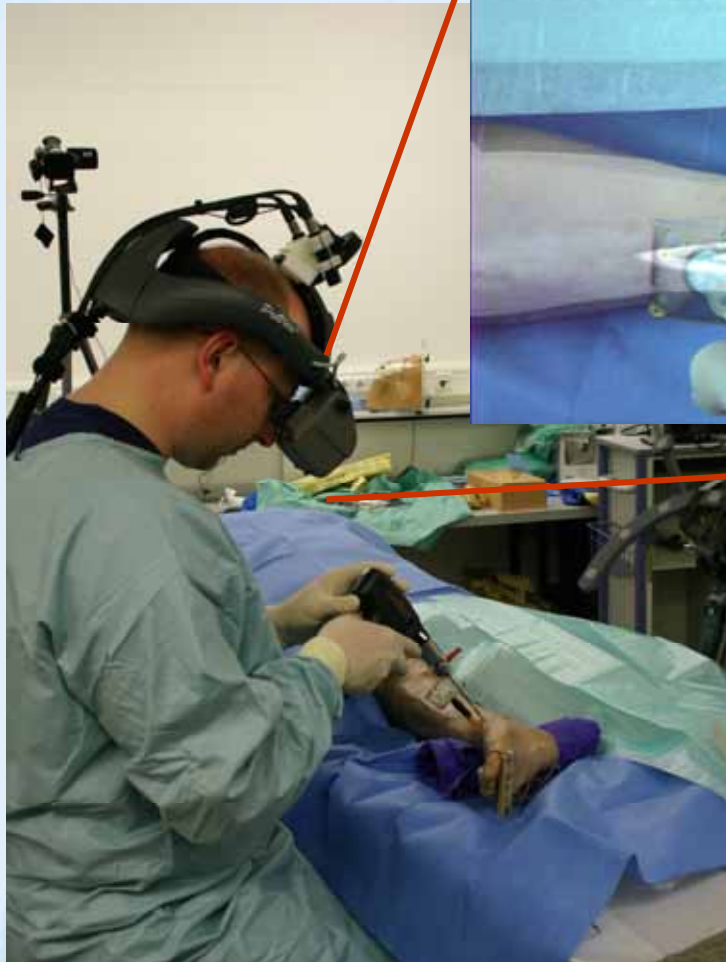
cadaver studies: pelvic c-clamp



cadaver studies: pelvic c-clamp



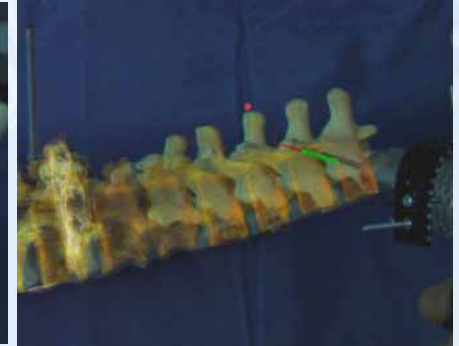
J. Traub, S. Philipp, N. Navab, S.M. Heining: EVI - Easy visualization interface for trauma surgery; ISMAR 2005, Vienna 2005



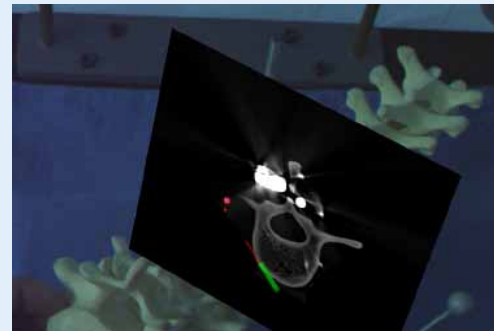
Lessons Learned:
Improvements in
Visualization Modes



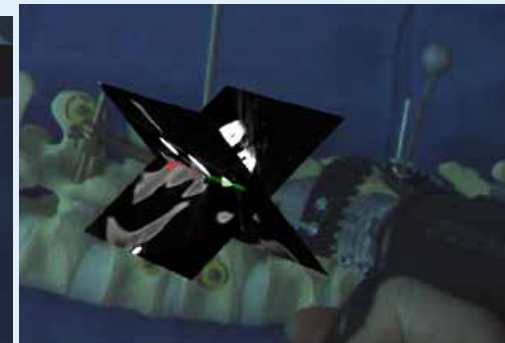
NAV
Standard Navigation



VOLREN
Volume Rendering

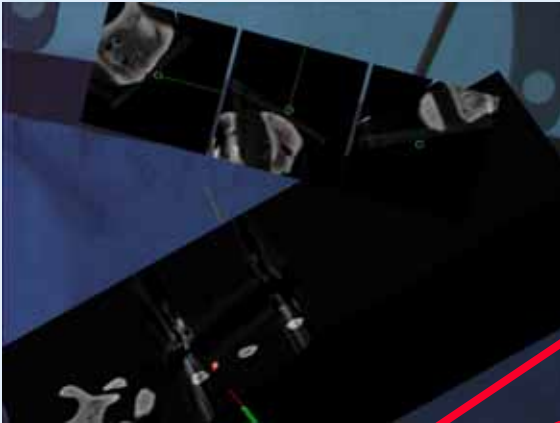


ASV
Aligned Slice View



IOV
Instrument Orthoslice View

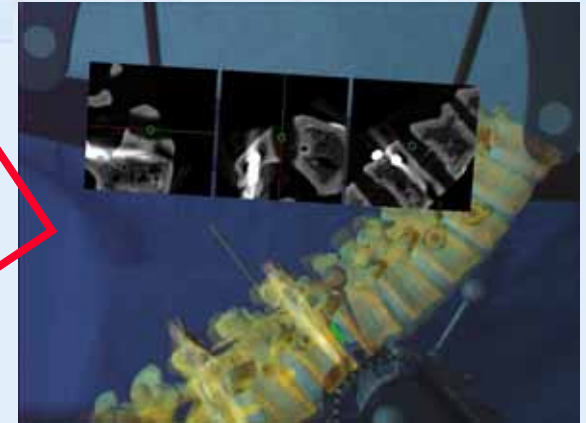
Hybrid Visualization Modes



NAV + IOV
Slice Navigation and
Instrument Orthoslice View



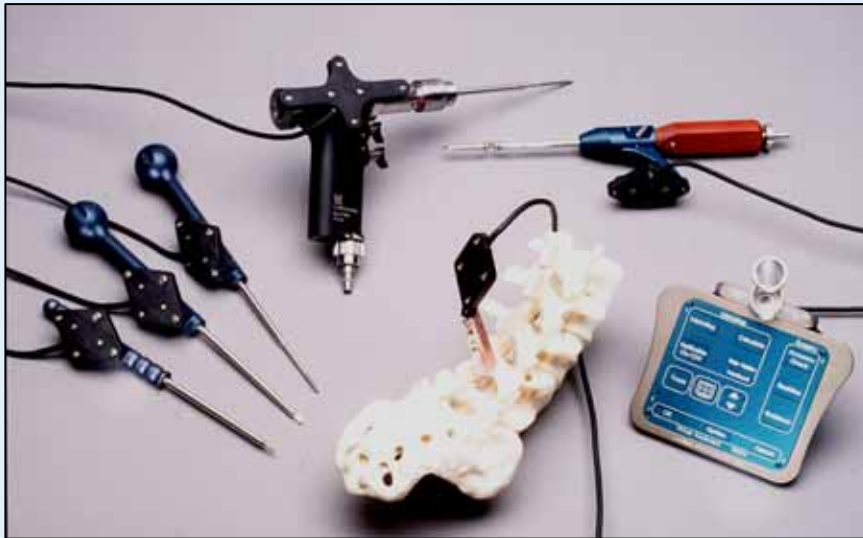
NAV+ASV
Slice Navigation and
Aligned Slice View



NAV+VOLREN
Slice Navigation and
Volume Rendering

adequate
visualization

LCP® DHHS™ Dynamic Helical Hip System



338.044 LCP DHHS Angle Guide-Variable



338.329 Calibrated Depth Gauge for LCP DHHS Angle Guide-Variable



338.332 Contoured Reamer 60 mm

900.723 2.5 mm Threaded Guide Wire Spade Point 230 mm



399.43 Hammer 700 Grams

338.345 LCP DHHS Coupling Screw 324 mm



338.342 LCP DHHS Key Instrument Shaft



338.346 LCP DHHS Inserter Shaft



338.347 LCP DHHS Key Impactor



338.341 LCP DHHS Inserter Guide

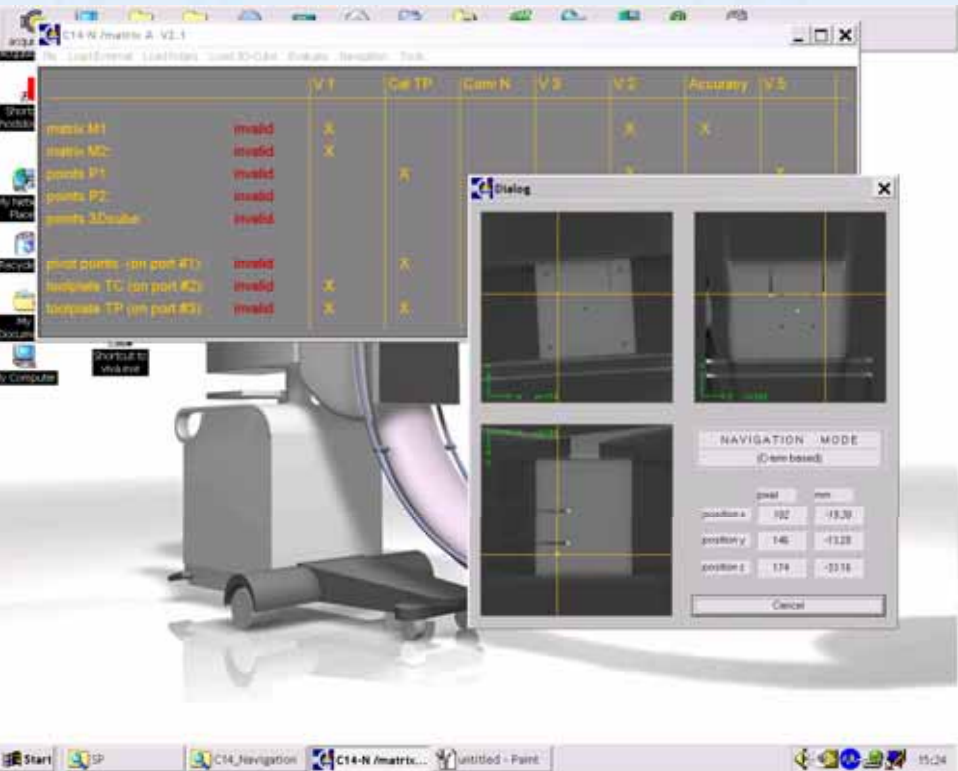


338.348 LCP DHHS Impactor Cap

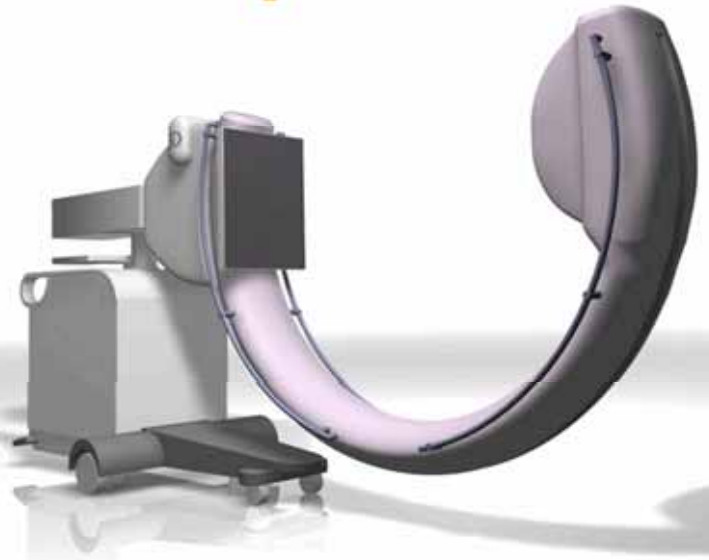


LCP DHHS Instruments for Implantation

standard
calibrated
instruments



System Alpha



3D scan sequence	Online initialization
2D fluoro images	3D start position
Parameters...	3D stop position

Images / time: 200p, 64s, 3.1fps

FD / mode typ: 4030CB / 2x1DGR

Image dimensions: 1024*1536*2, 2x2

Analog gain: g=1 (Saturation: 14000)

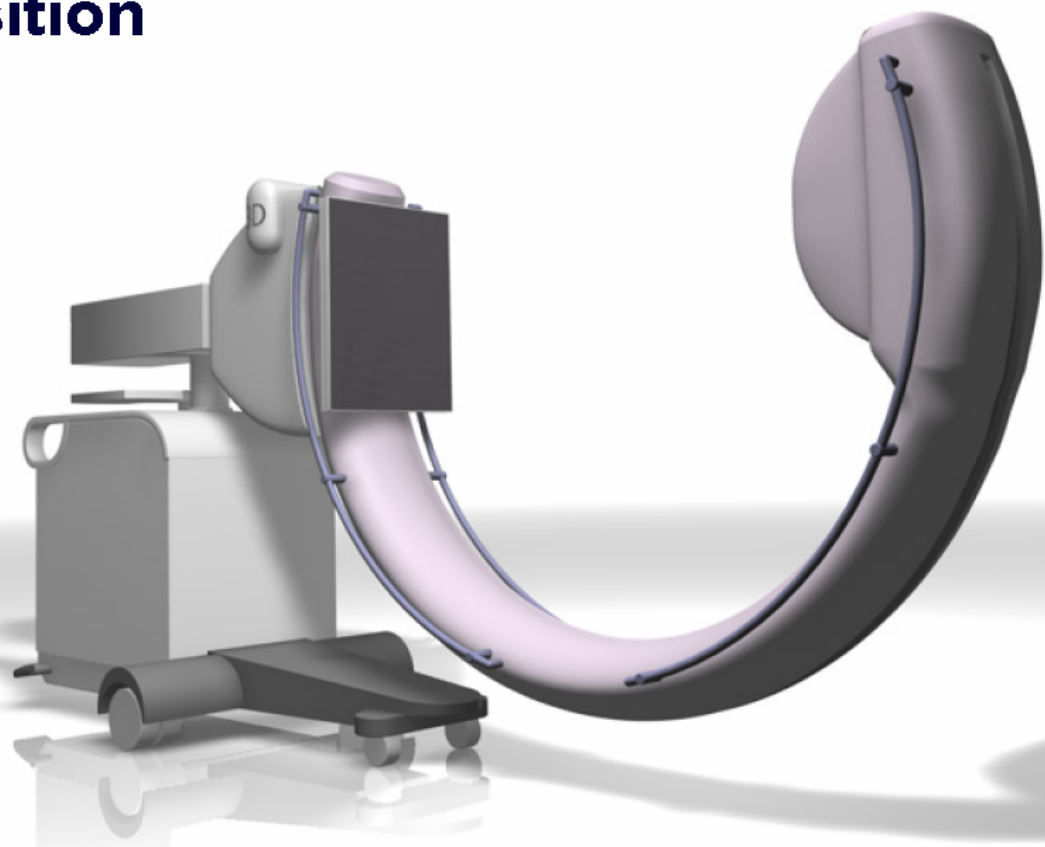
PaxScan mode info: 3 2x1 15 fps Gn1 0p5/4p DGR

3Dscan

SIEMENS

C14 - prototype system

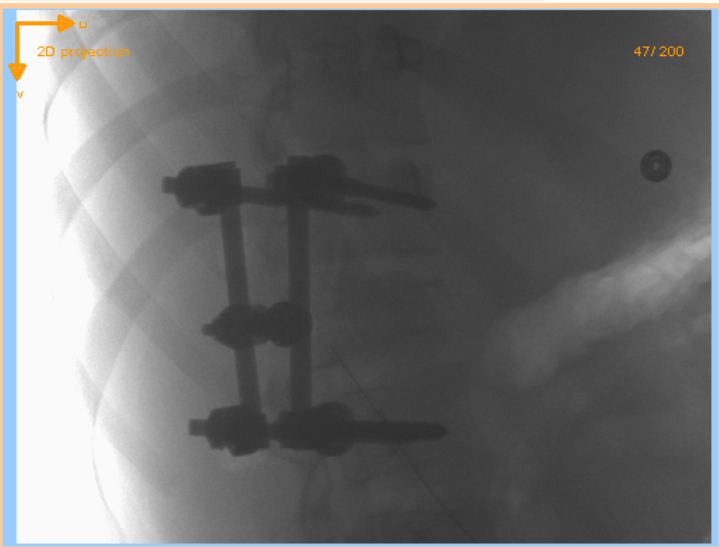
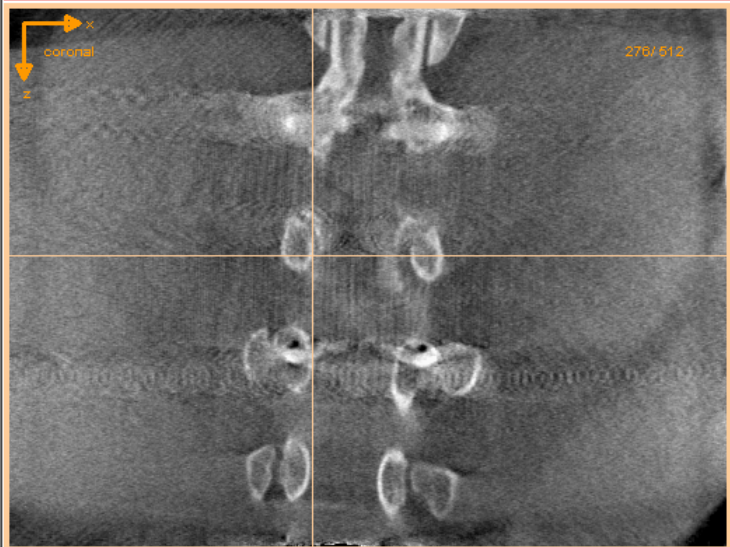
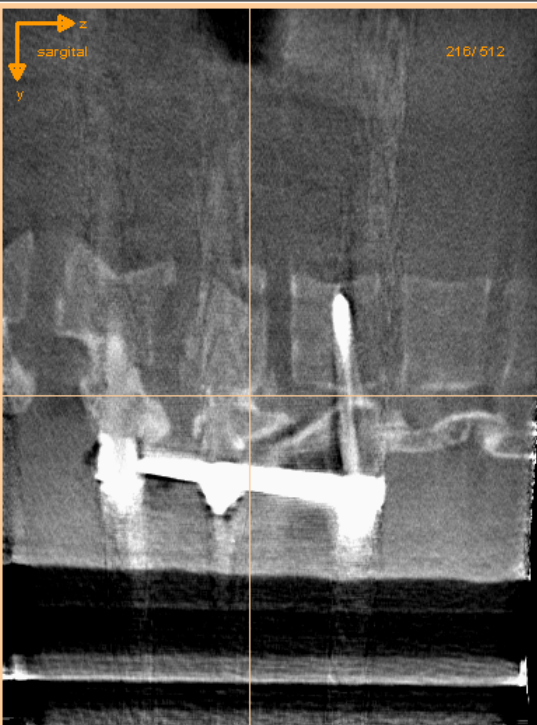
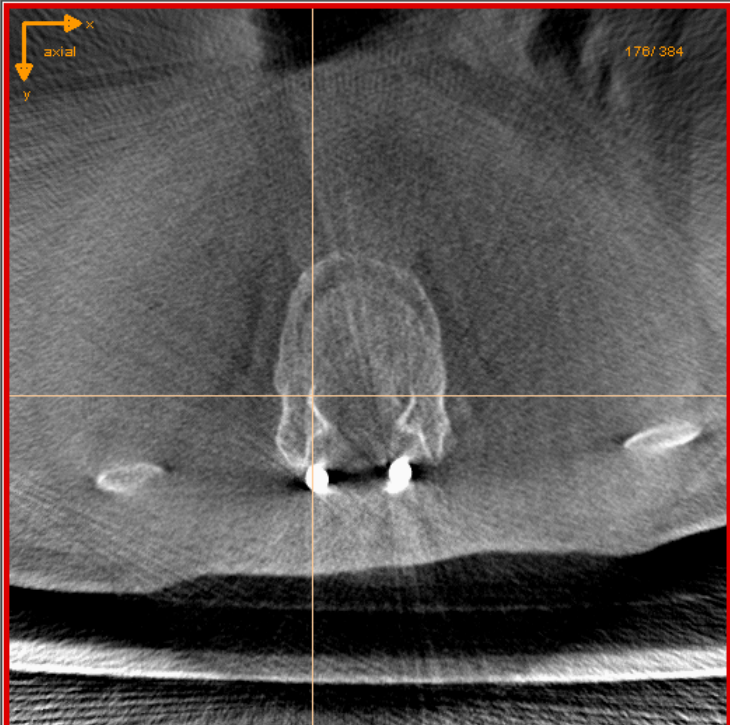
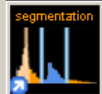
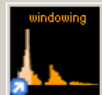
Acquisition



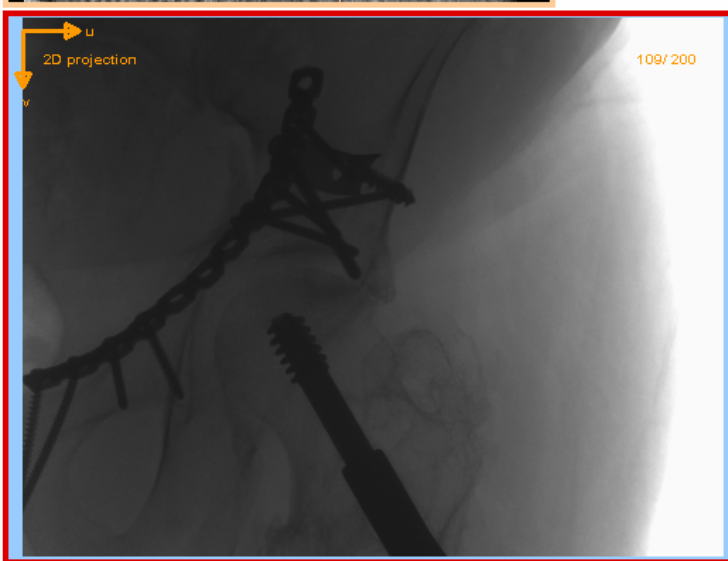
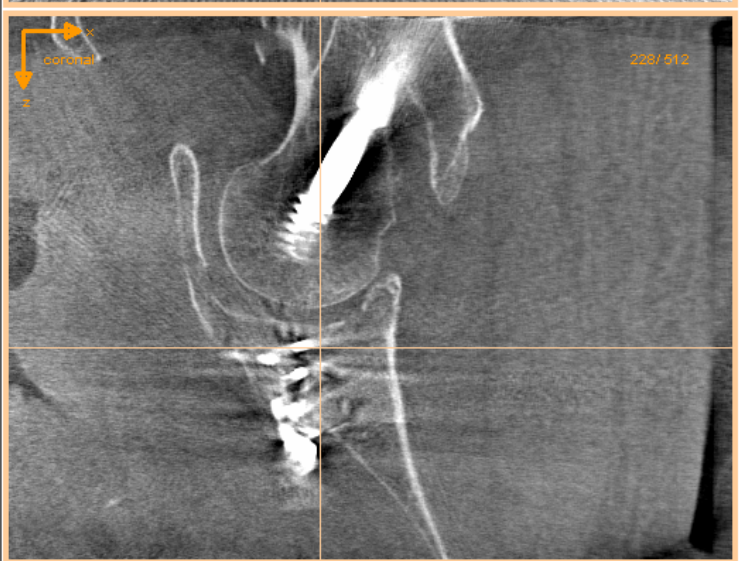
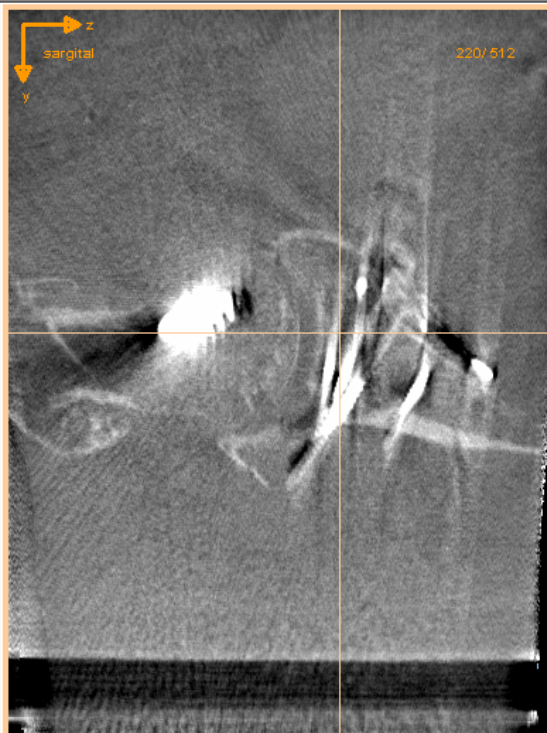
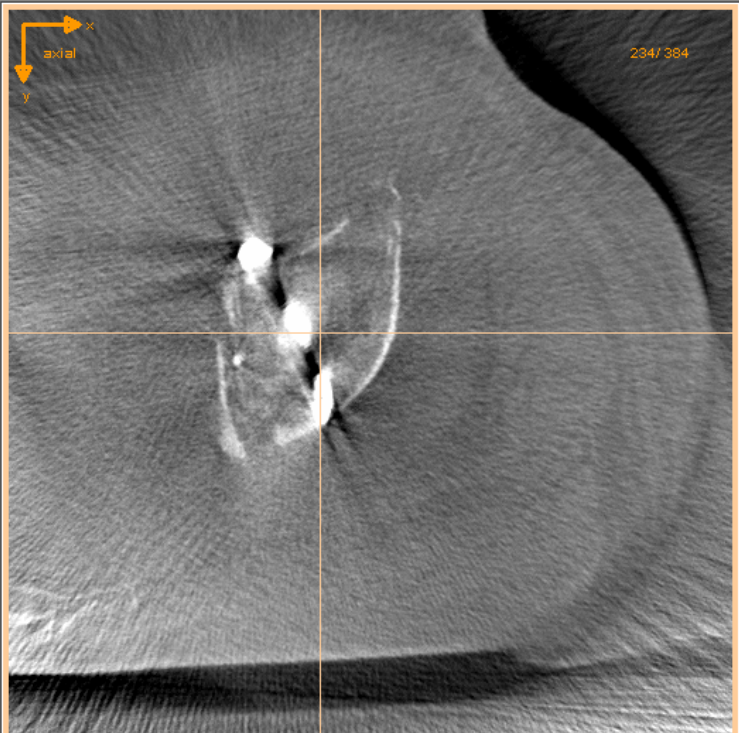
- xray_acqui...
- C14Studio
- 2D image s...
- 3D cube
- DICOM files
- Short_Inst...



S



control
windowing
segmentation
image zoom



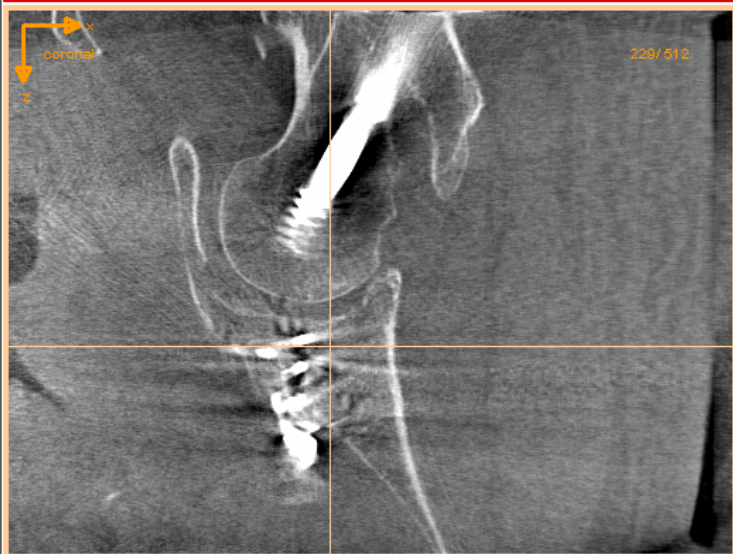
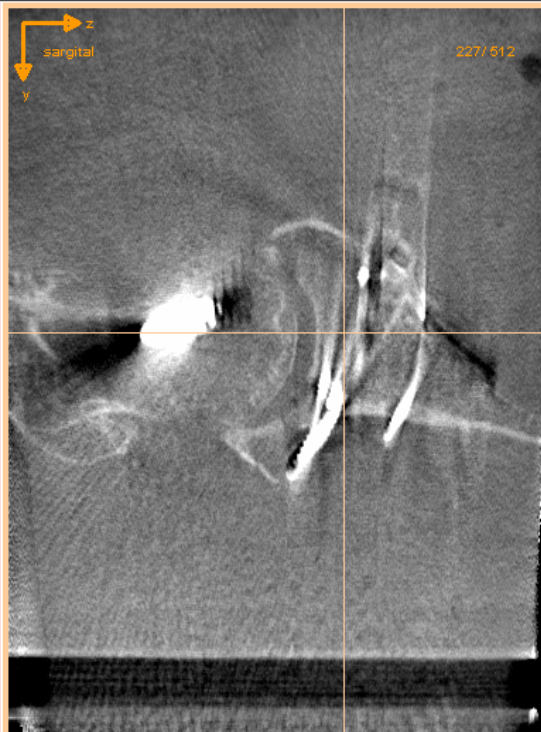
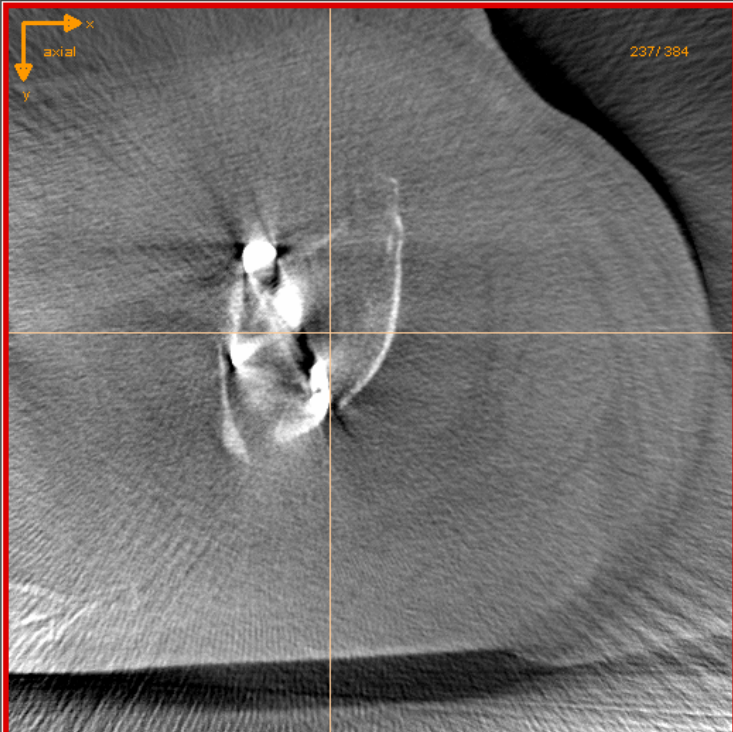
control

windowing

segmentation

image zoom

z

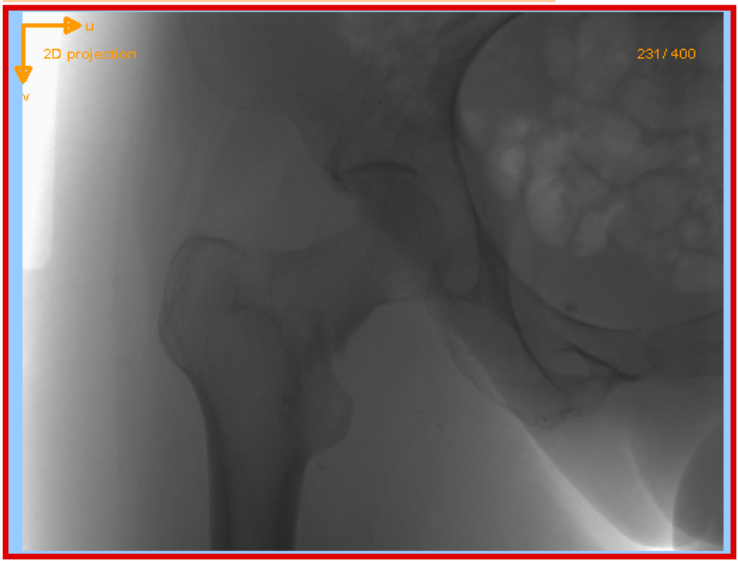
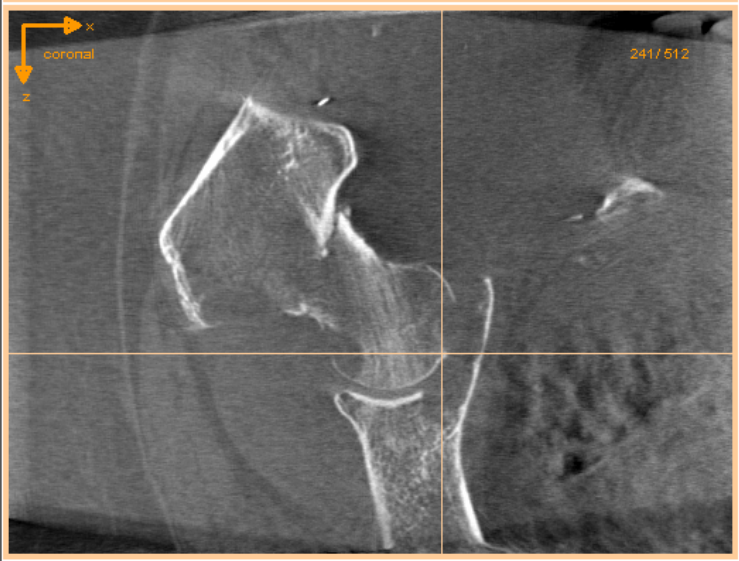
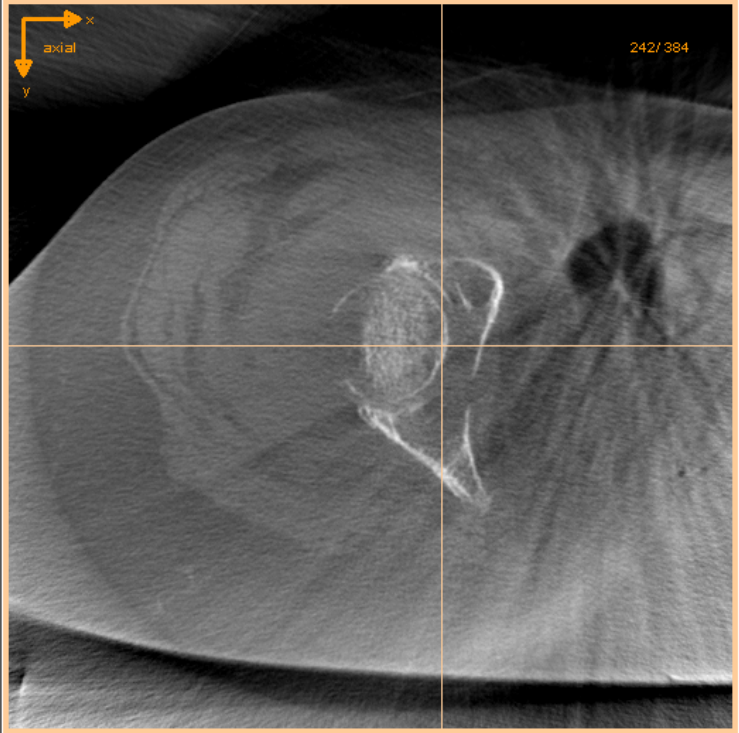


control

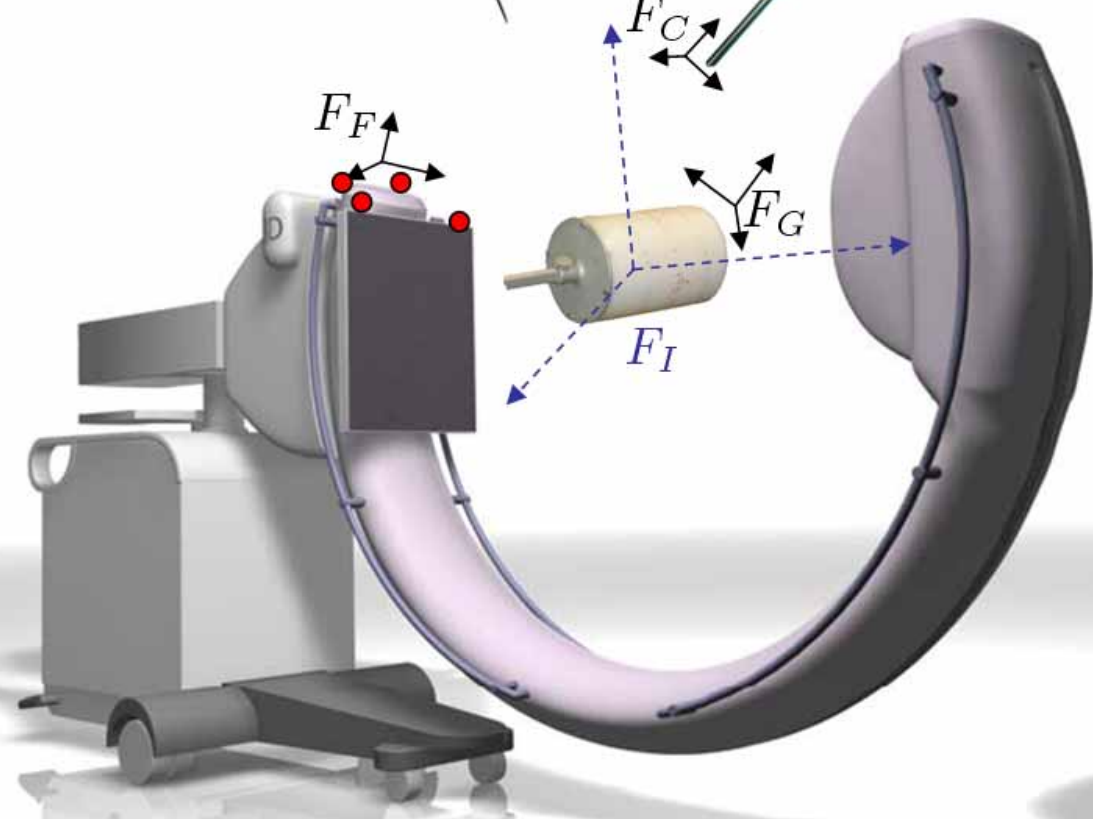
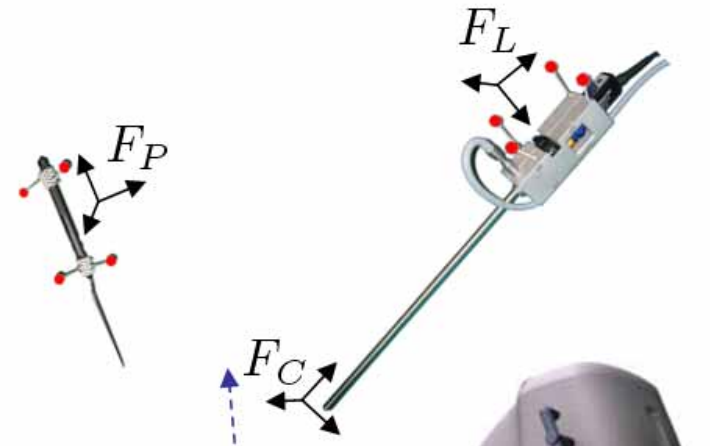
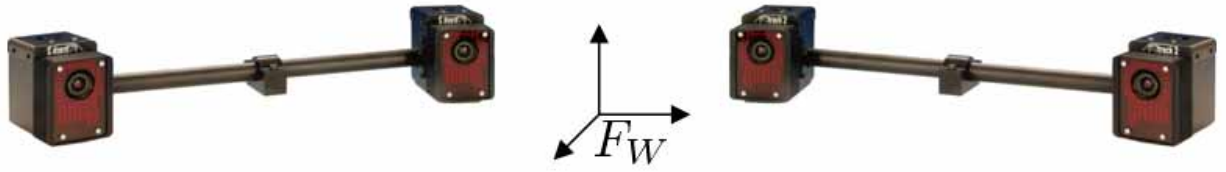
windowing

segmentation

image zoom

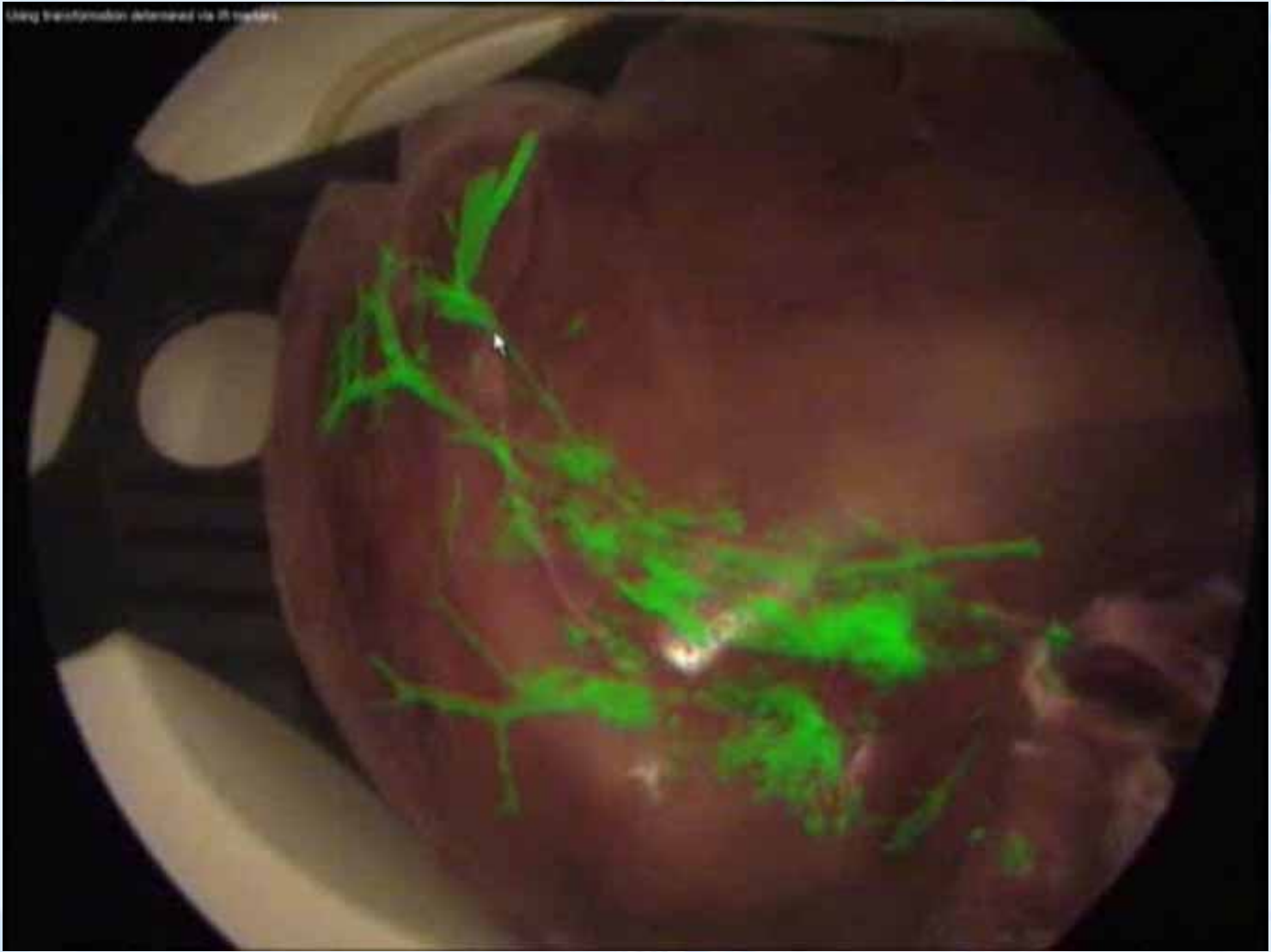








Using bioinformatics determined via 2D gel electrophoresis

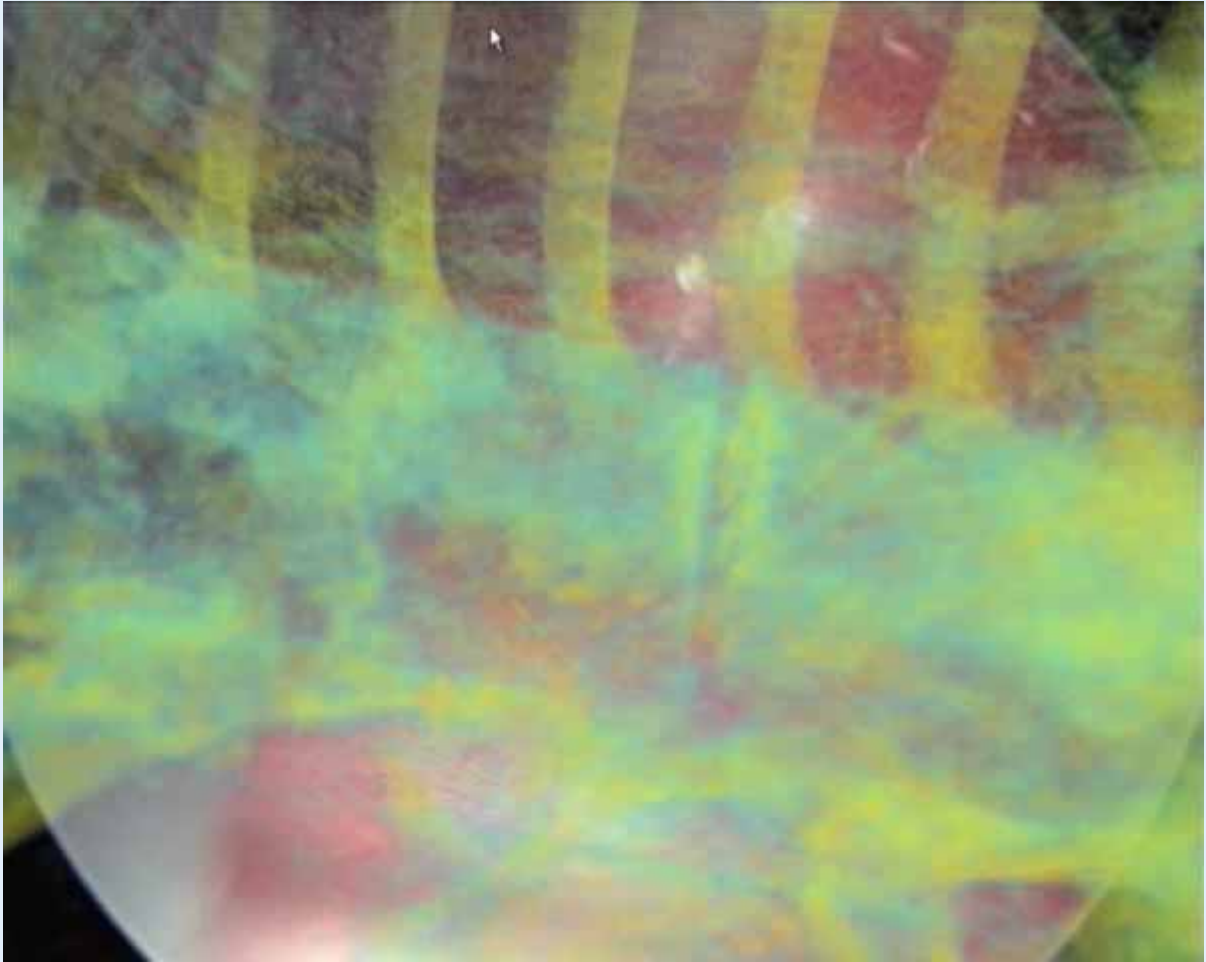


Using transformation determined via 3D markers



Registration-Free Laparoscope Augmentation for Liver Resection

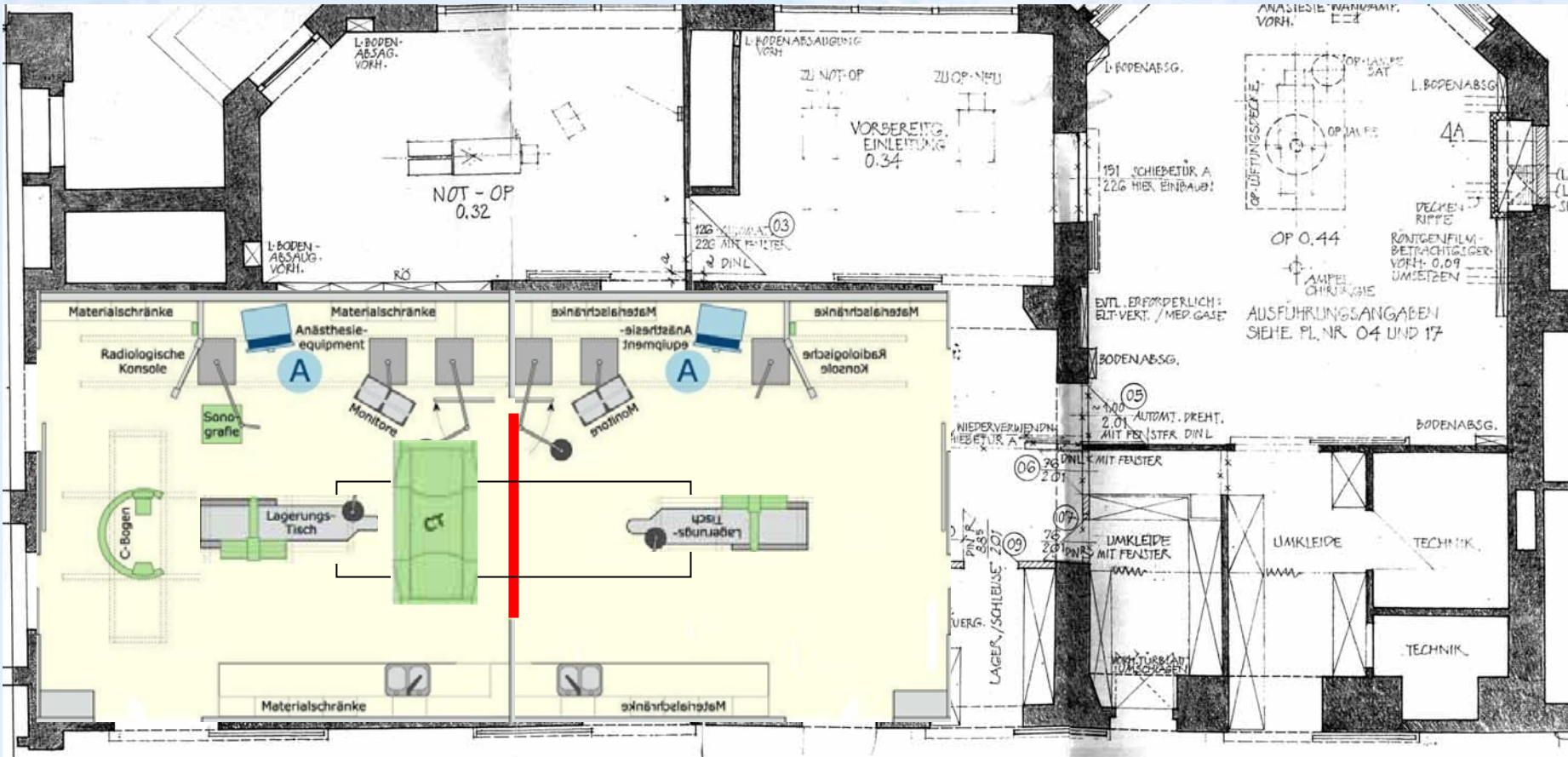


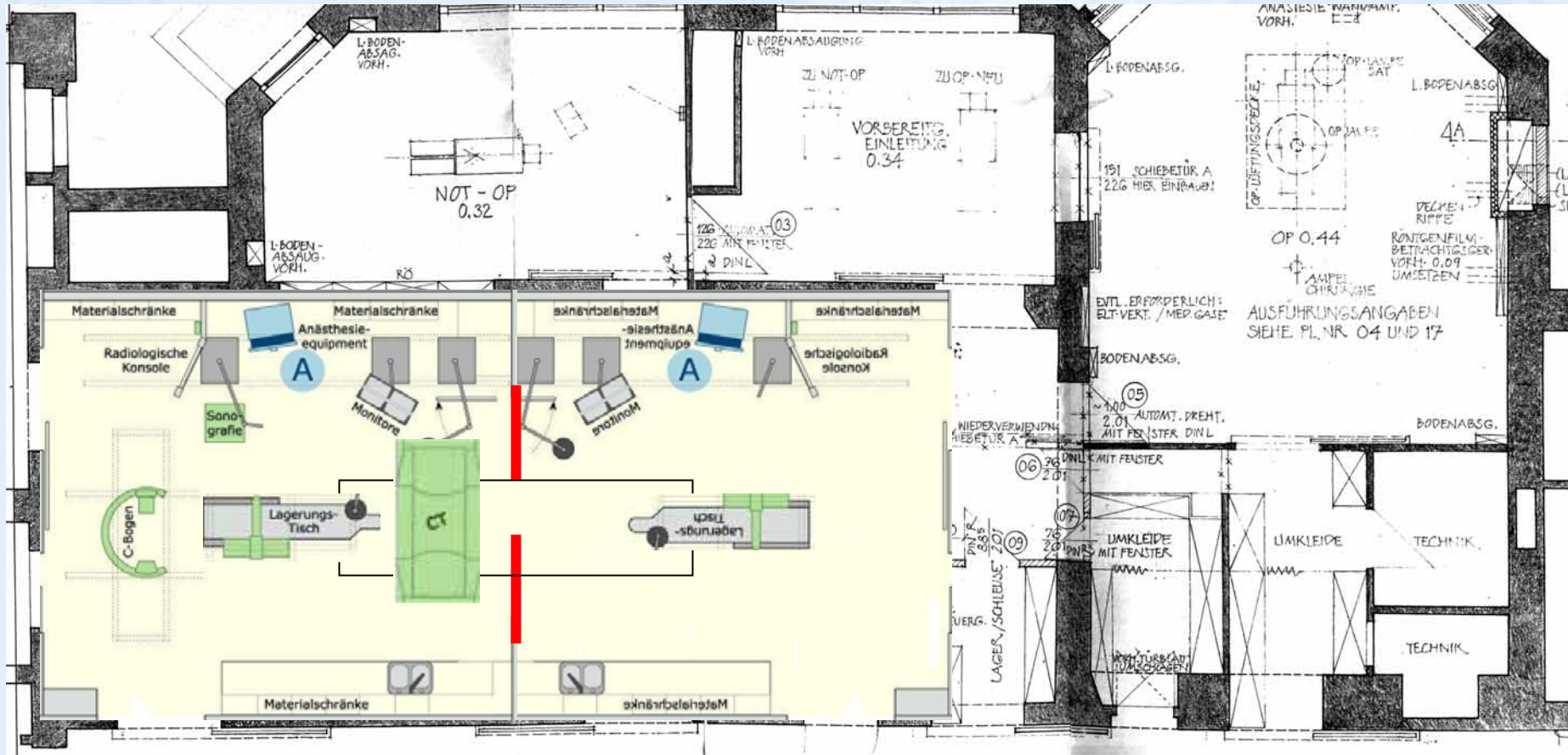


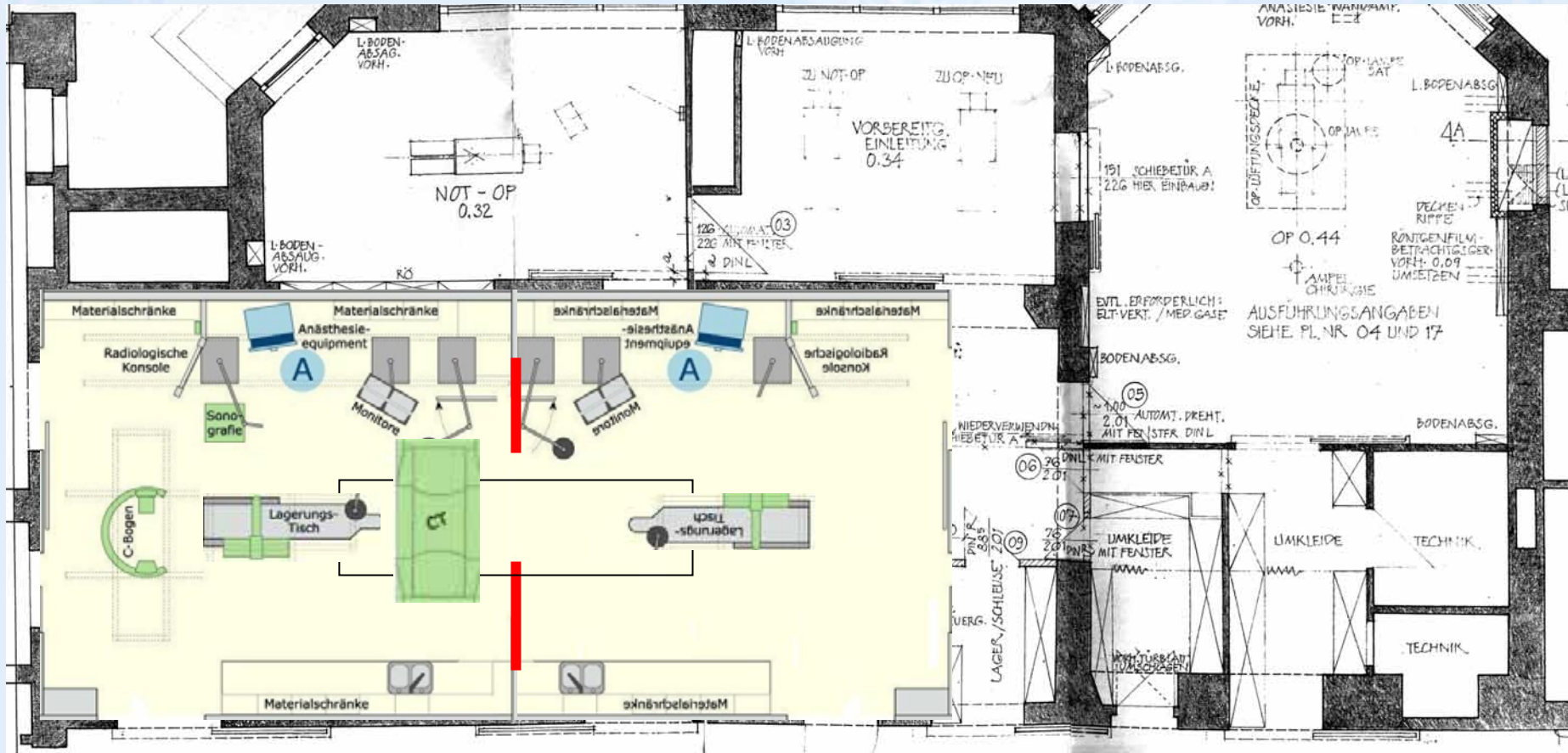
Video-Augmented X-ray Fluoroscopy CAMC

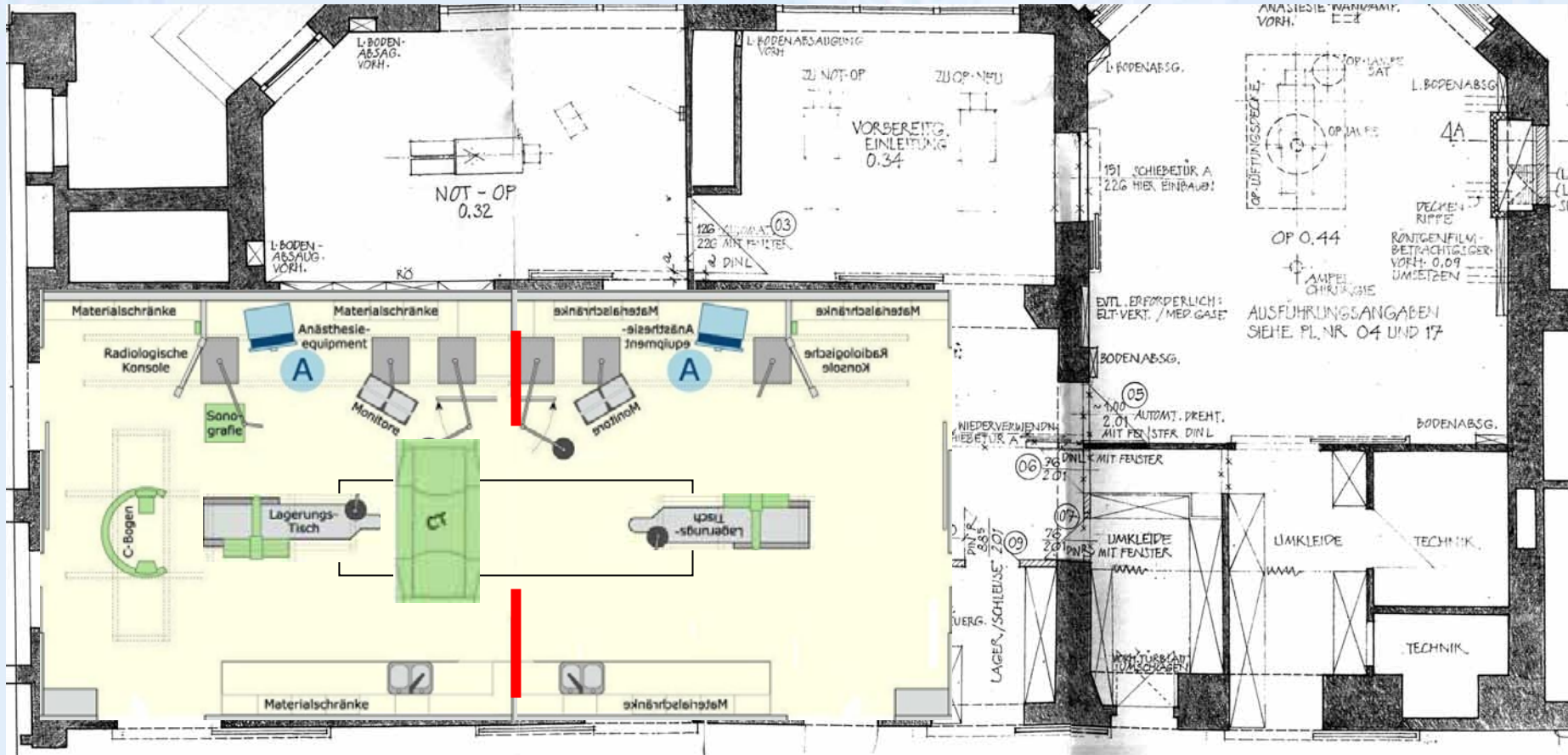


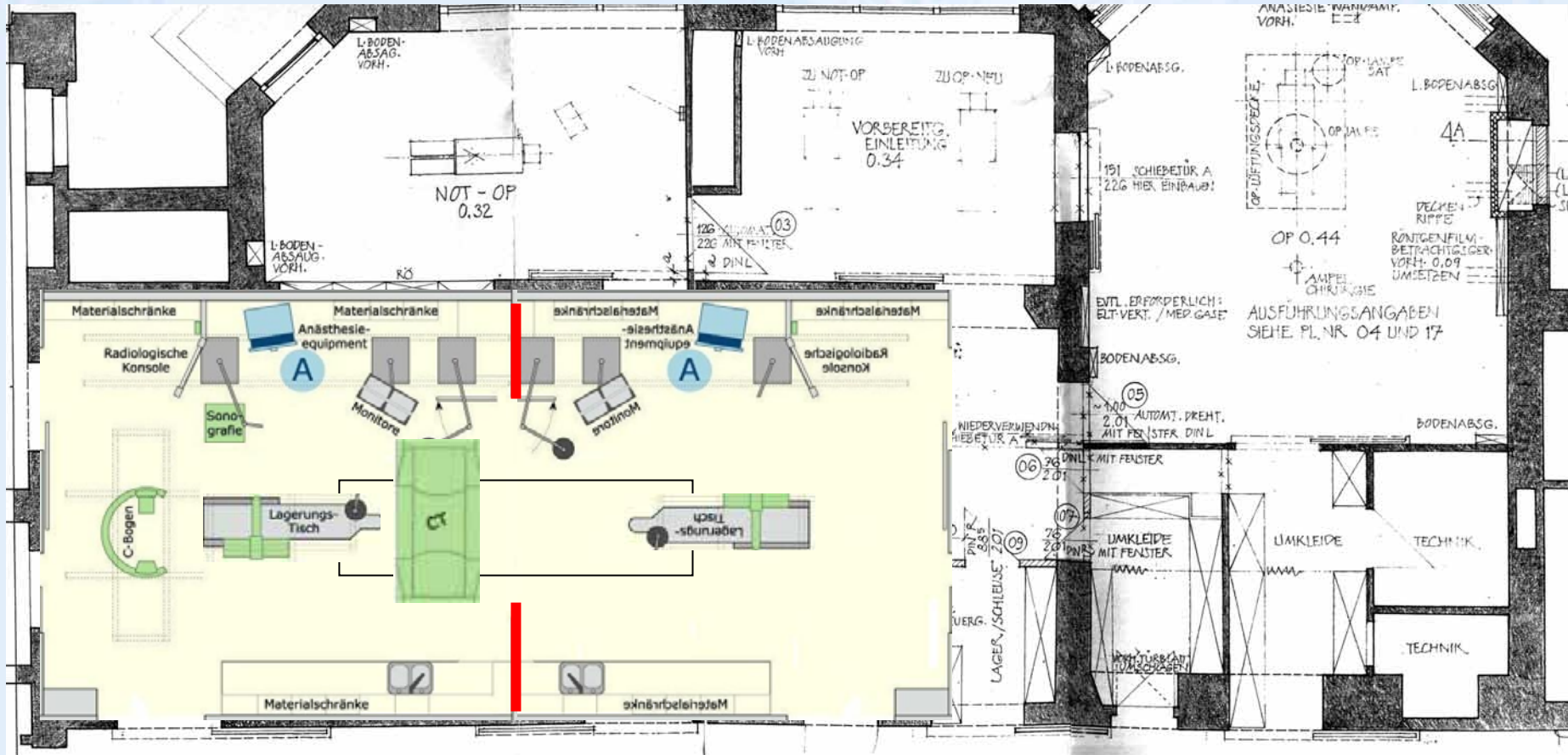








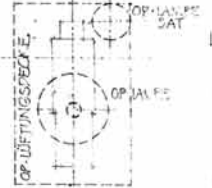




NOT-OP
0.32

VORBEREITG.
EINLEITUNG
0.34

ANÄSTHESIE WÄRMENP. VORH.



4A

OP 0.44

AMPEL CHIRURGIE

AUSFÜHRUNGSANGABEN
SIEHE PL. NR. 04 UND 17

EVTL. ERFORDERLICH:
ELT. VERT. / MED. GASE

BODENABSG.

~100 AUTOM. DREHT.
2.01 MIT PER. STER. DIN L

WIEDERVERWENDUNG
HIEBETÜR A

06

26 DIN L MIT FENSTER
2.01

07

26 DIN L MIT FENSTER
2.01

09

LAGER-/SCHLEIBE 2.01

VERG.

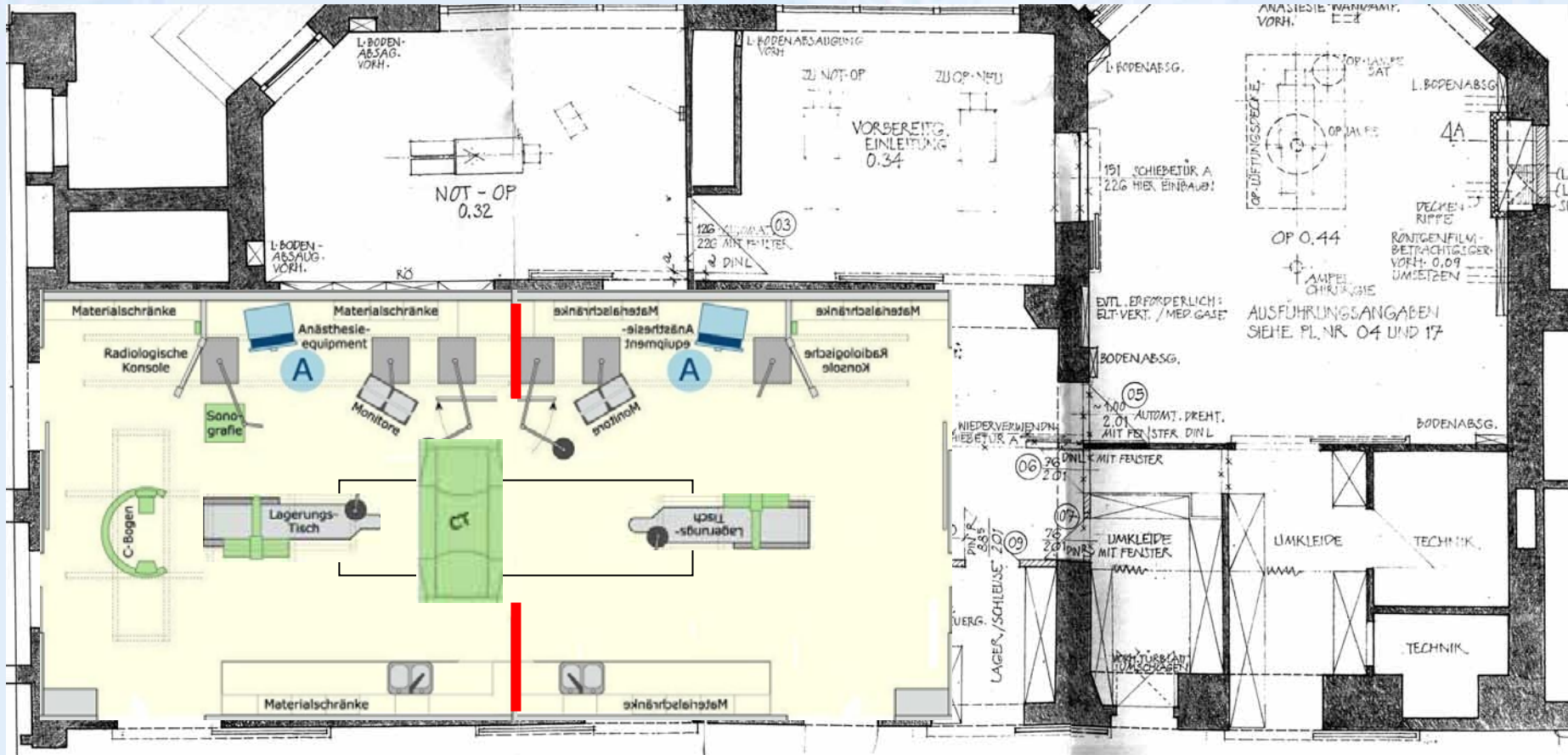
UMKLEIDE
MIT FENSTER

UMKLEIDE

TECHNIK

TECHNIK

BODENABSG.



L. BODEN-ABSAG. VORH.
 NOT-OP 0.32

L. BODEN-ABSAG. VORH.
 ZU NOT-OP
 ZU OP-NEU
 VORBEREITG. EINLEITUNG 0.34

ANÄSTHESIE WÄRMENP. VORH.
 OP-ANLAGE SAT
 OP-ANLAGE
 L. BODEN-ABSAG.
 4A
 191 SCHIEBETÜR A 22G HIER, EINBAU!
 OP 0.44
 AMPEL CHIRURGIE
 RÖNTGENFILM-BETRACHTIGER VORH. 0.09 UMSETZEN
 DECKEN RITZE

AUSFÜHRUNGSANGABEN SIEHE PL. NR. 04 UND 17

BODEN-ABSAG.

05
 ~100 AUTOM. DREHT. MIT PER. STER. DIN L

WIEDERVERWENDB. HIEBETÜR A
 06
 26 DIN L MIT FENSTER 2.01

07
 26 DIN L MIT FENSTER 2.01

09
 LAGER-/SCHLEIBE 2.01

BODEN-ABSAG.

TECHNIK

TECHNIK

Materialschränke

Anästhesie-equipment

Radiologische Konsole

Sonografie

Monitore

Materialschränke

Anästhesie-equipment

Radiologische Konsole

Monitor

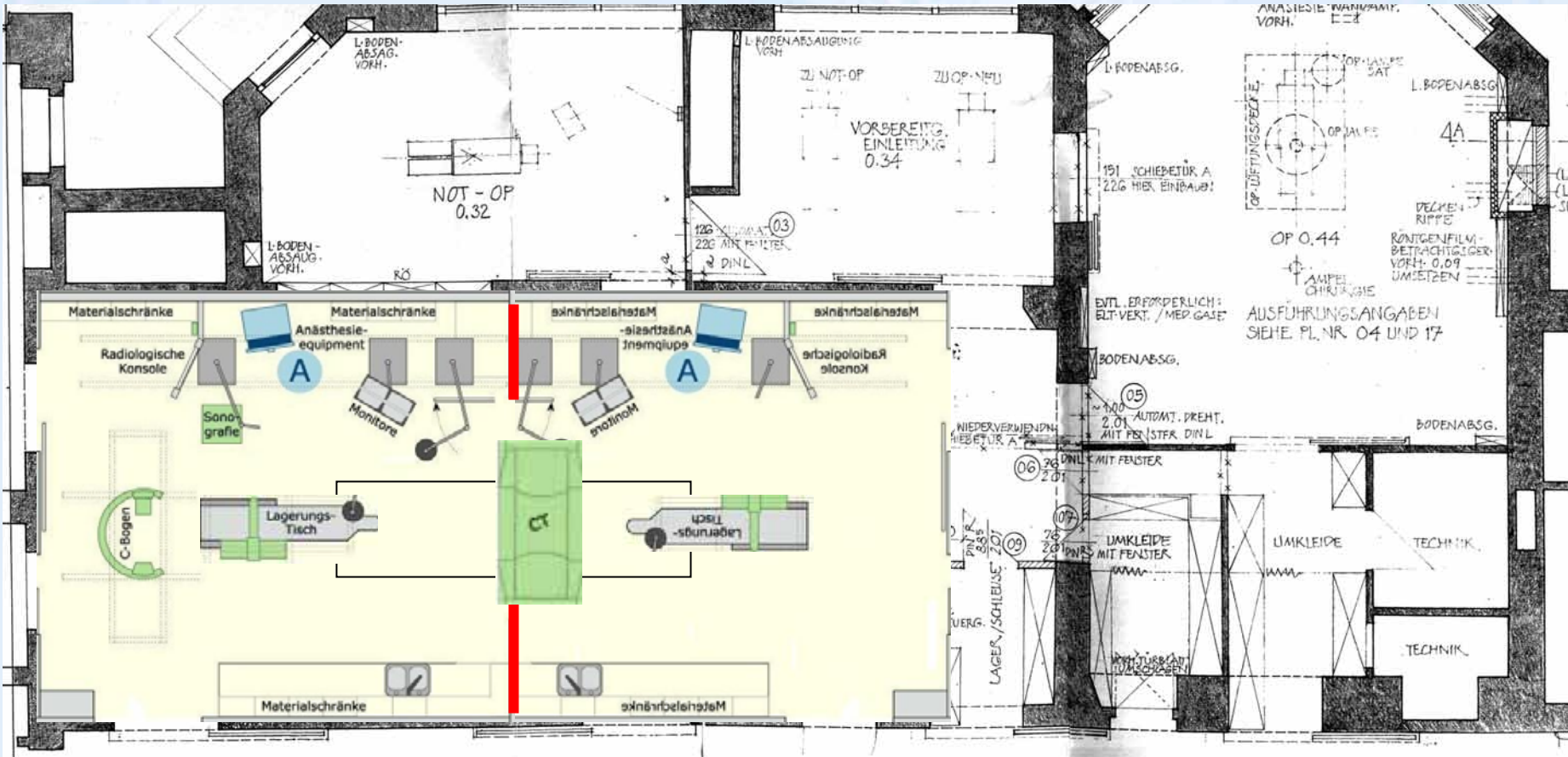
Lagerungs-Tisch

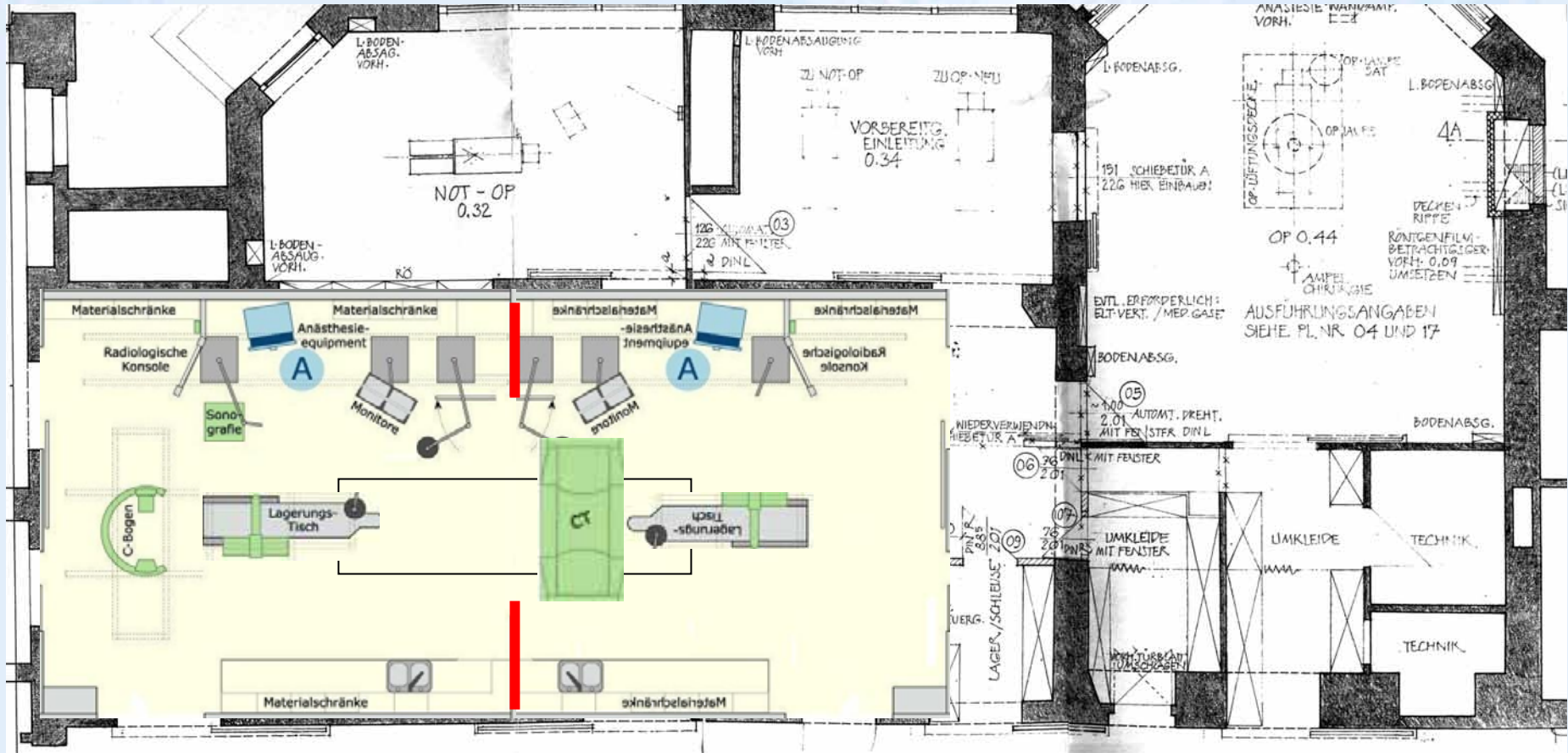
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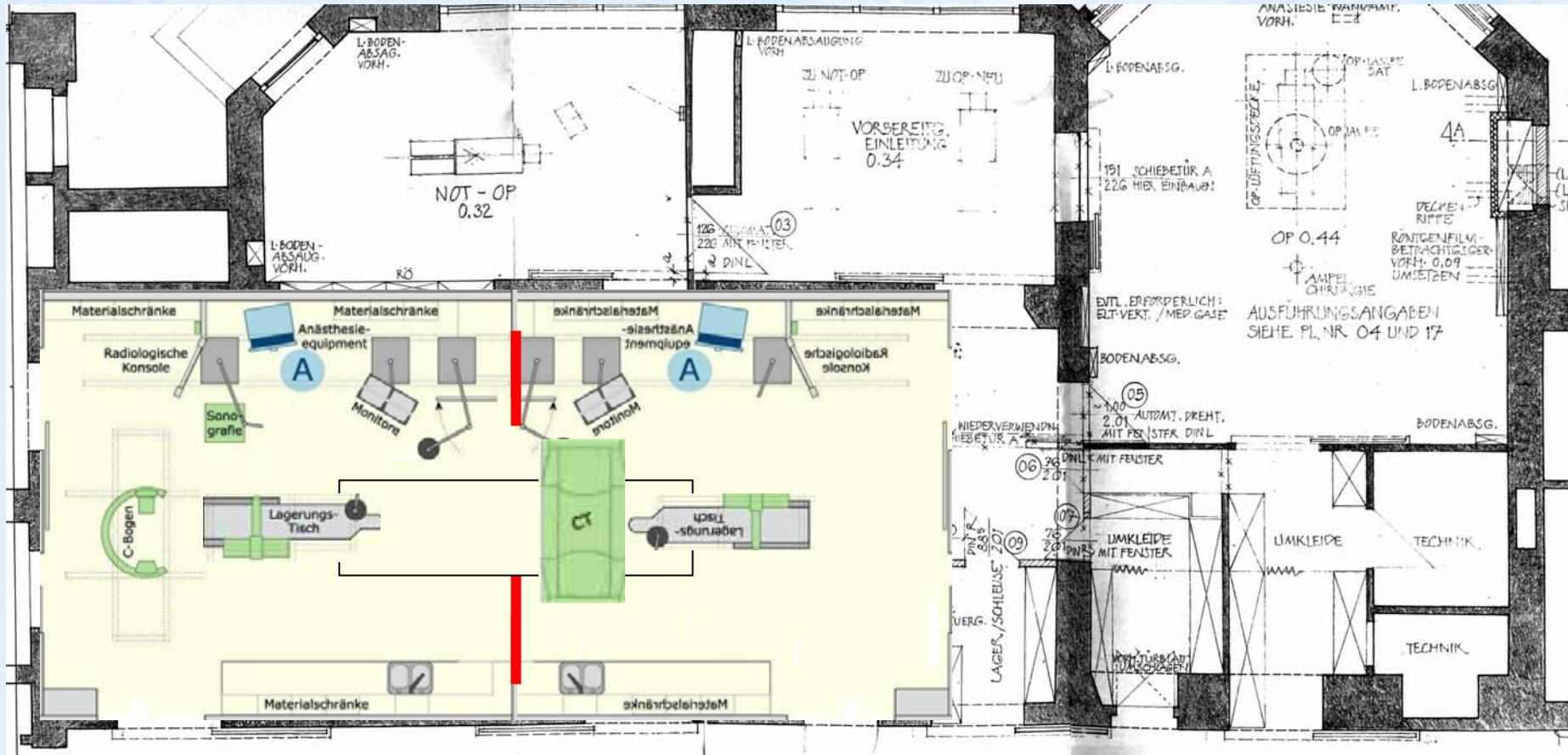
Materialschränke

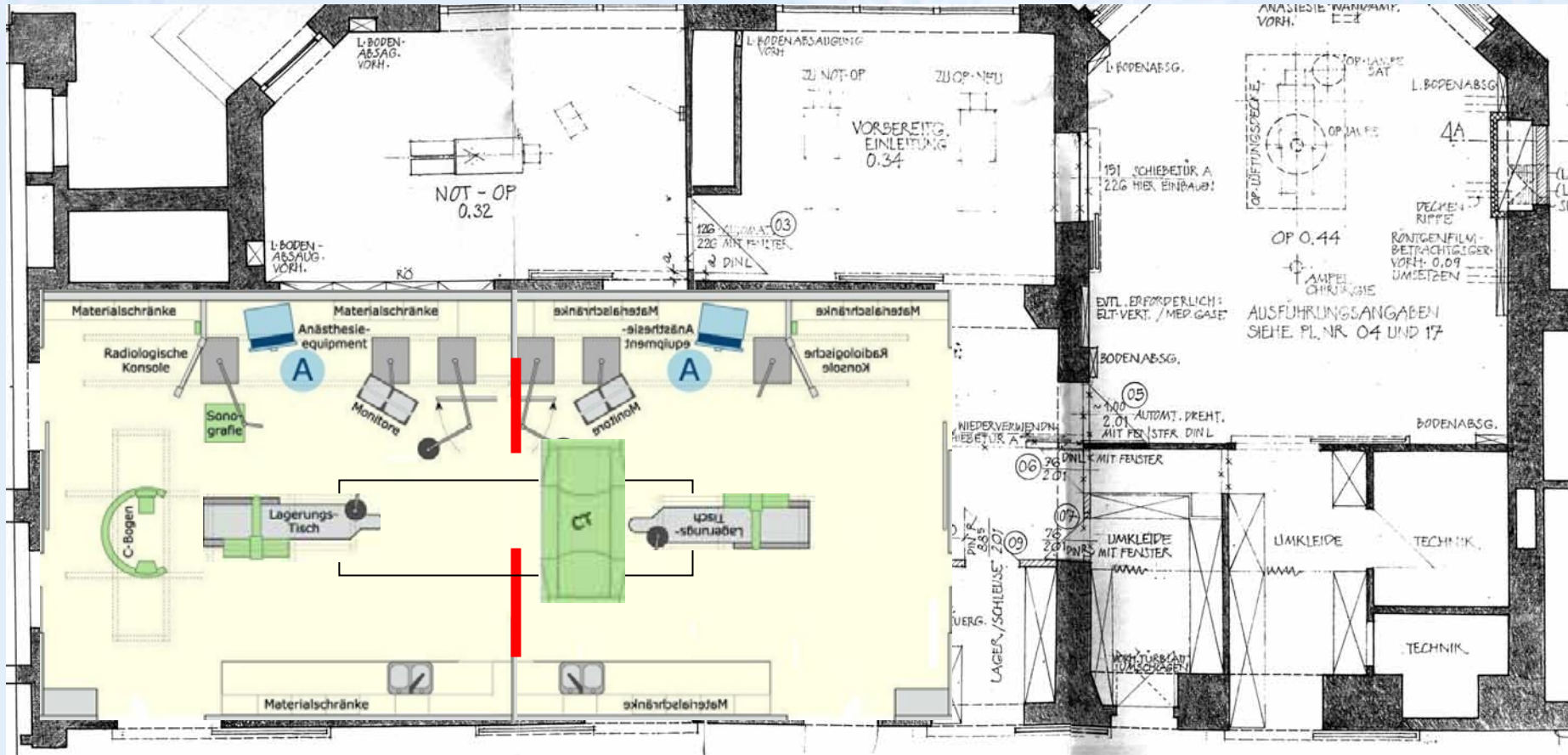
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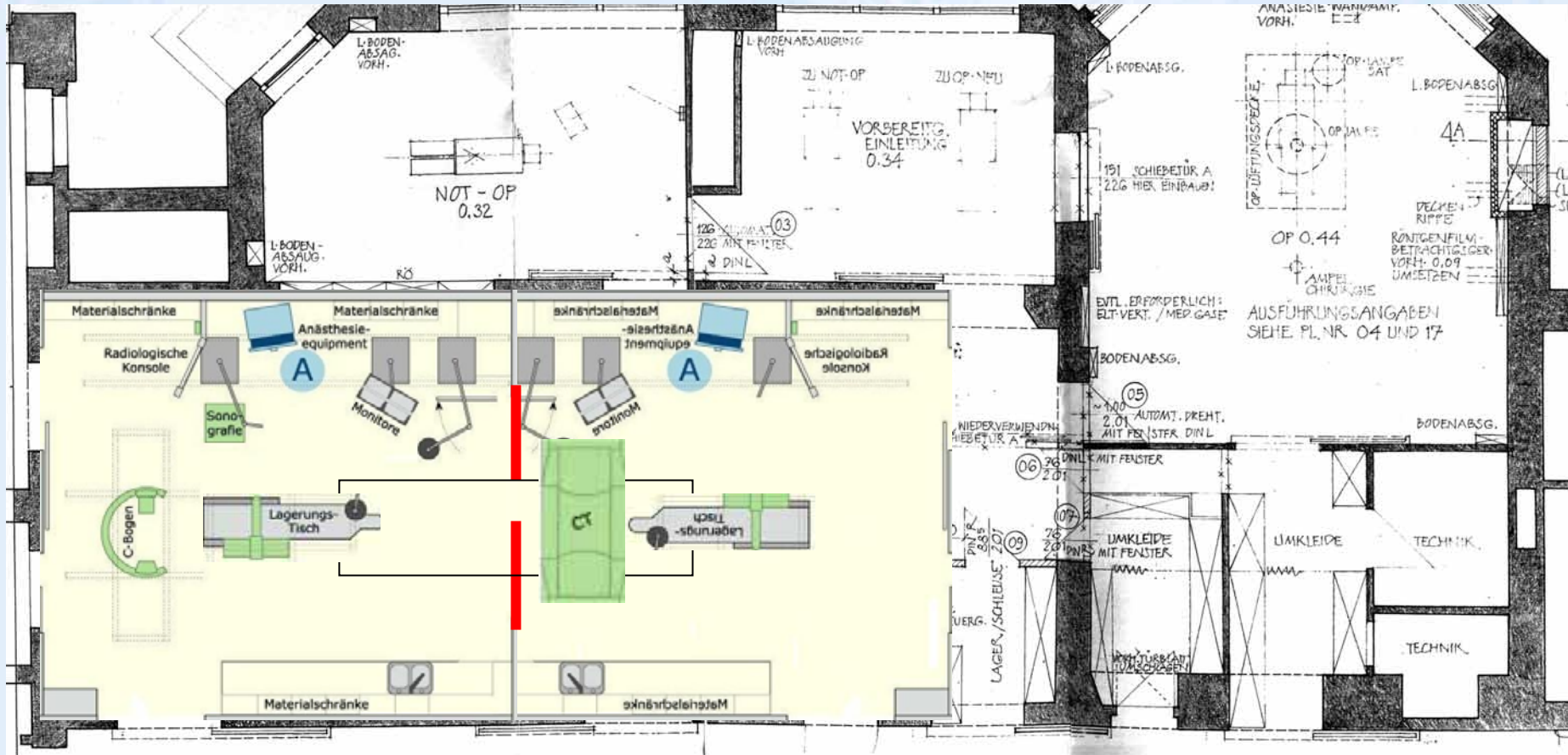
LAGER-/SCHLEIBE 2.01
 VERG.

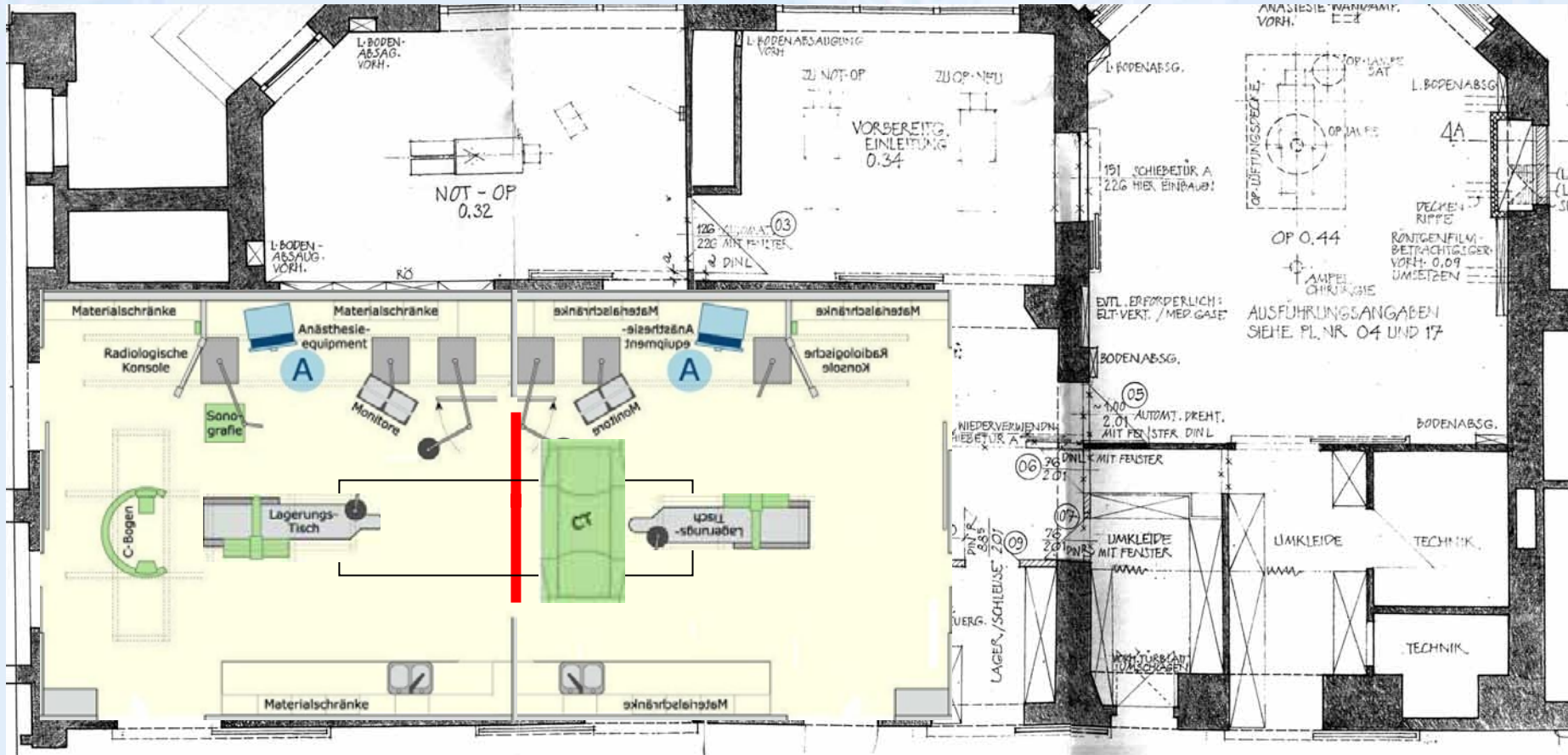


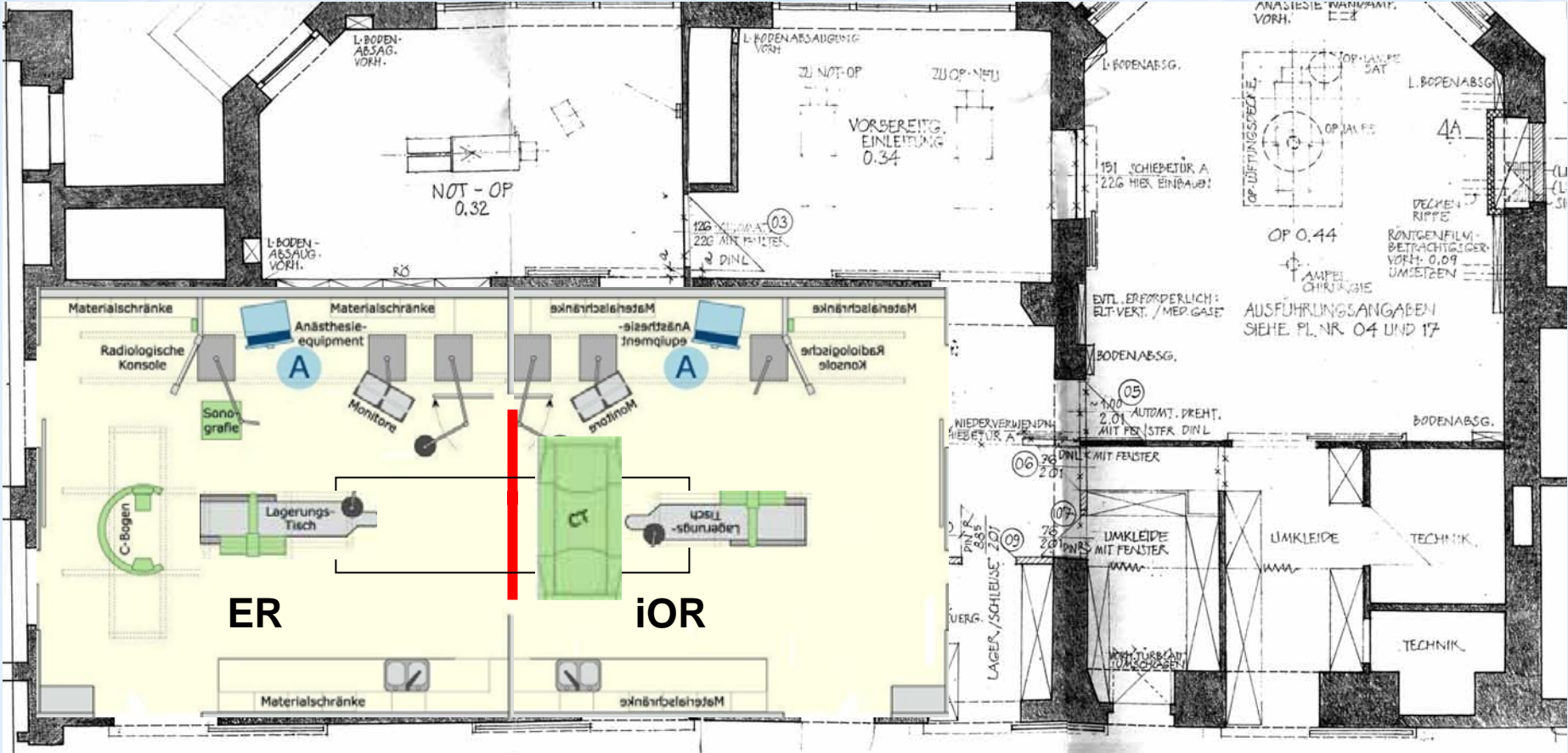


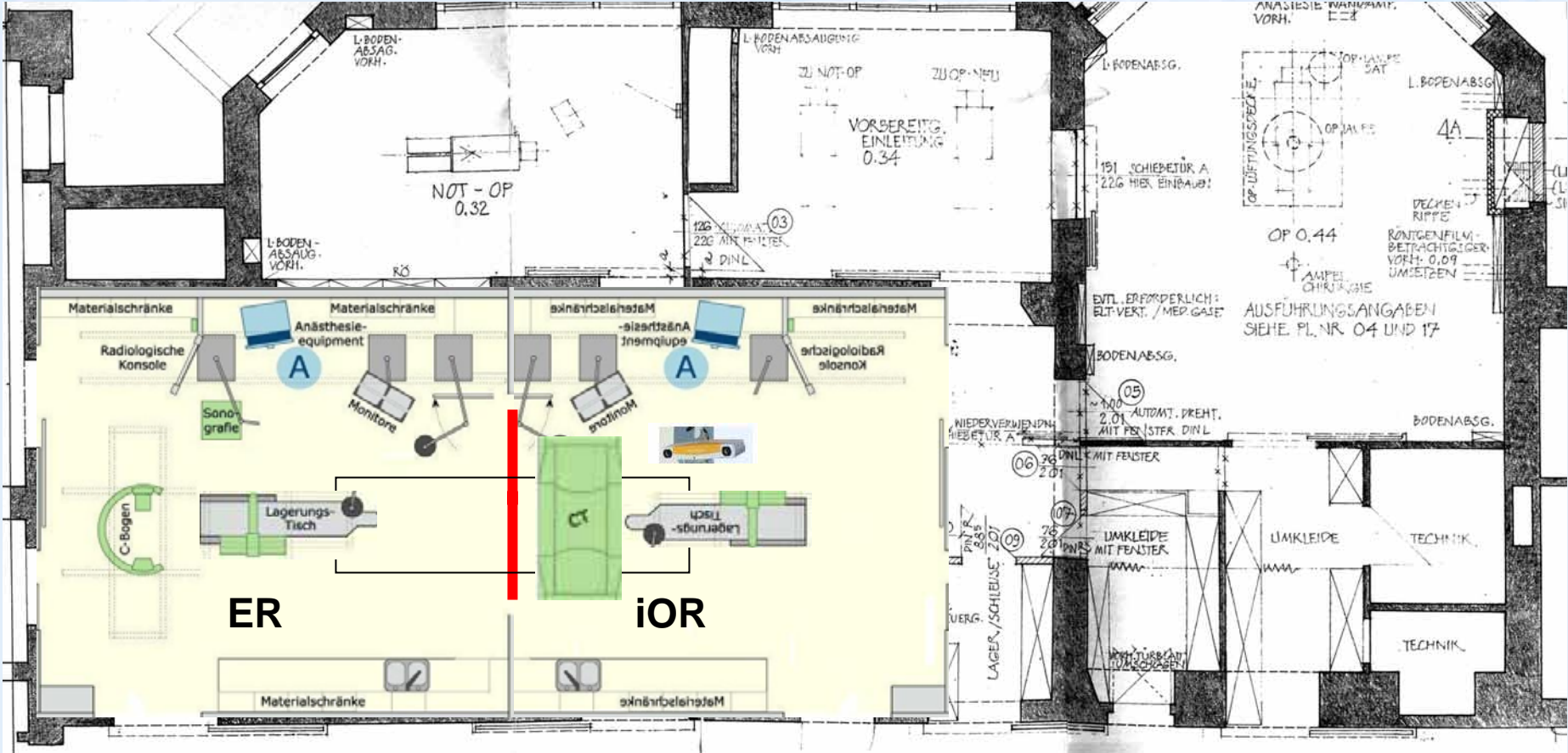


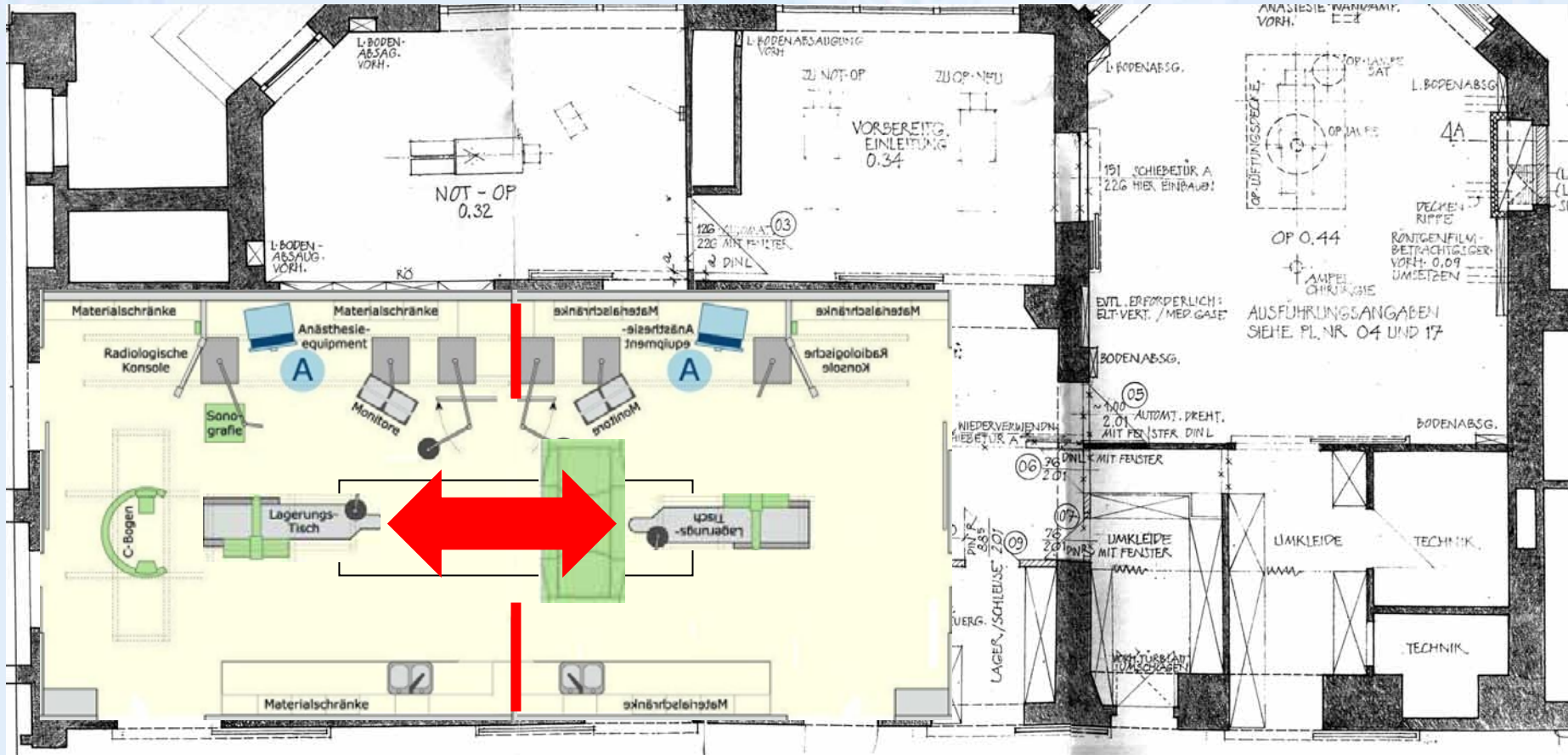


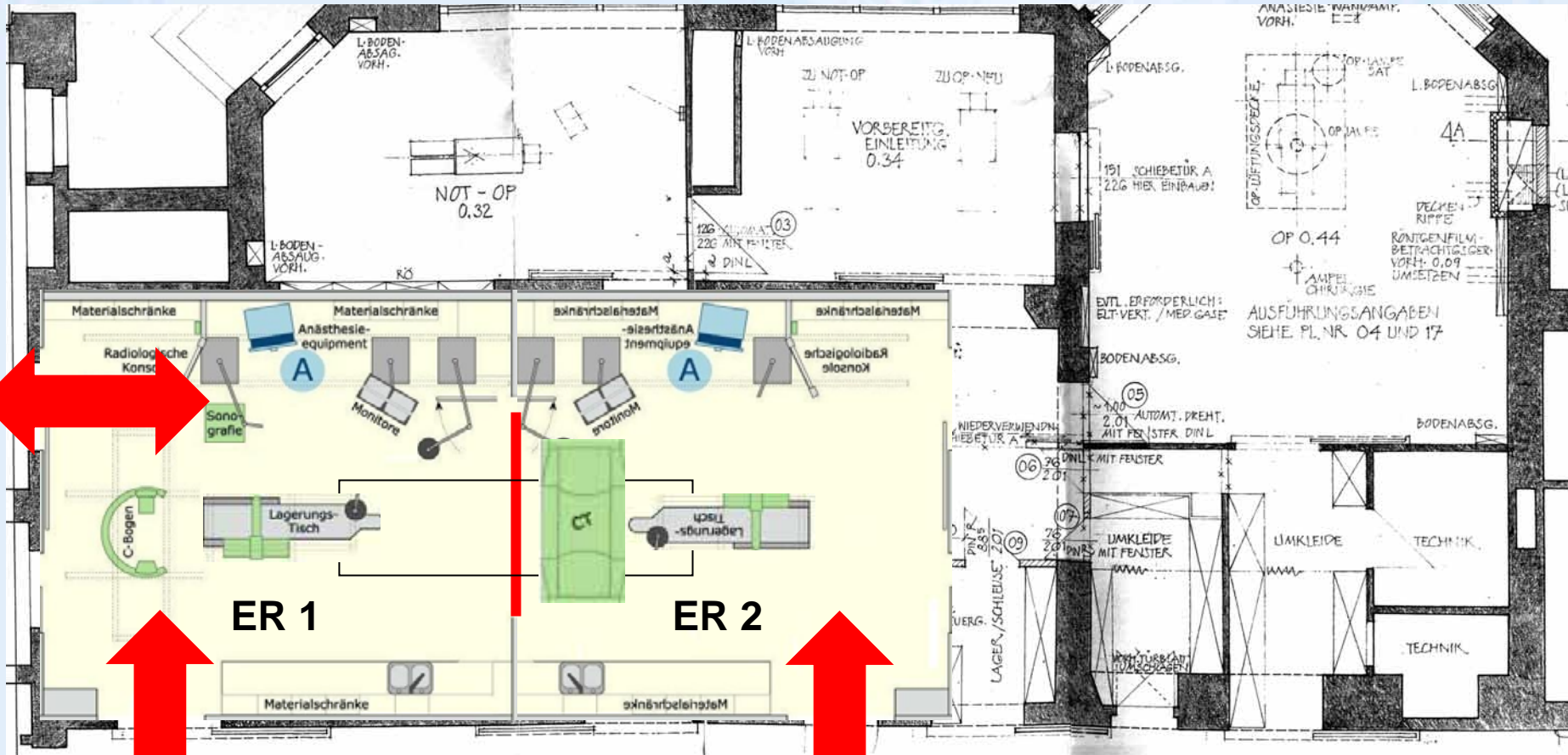






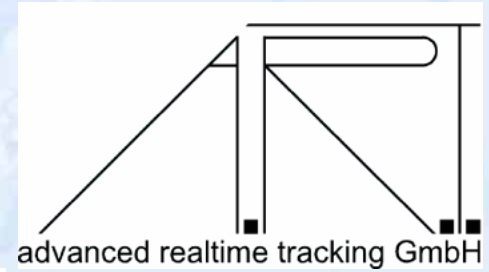








intraoperative
imaging



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SIEMENS



Bayerische
Forschungsstiftung



LMU