



## ***3D PRINTED CUSTOM-MADE IMPLANTS: FROM DEMAND TO SURGERY***

Peter Scheinemann

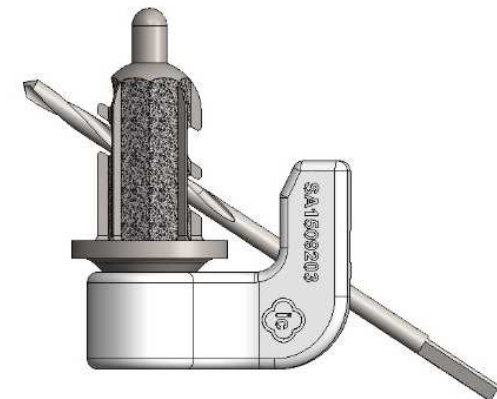
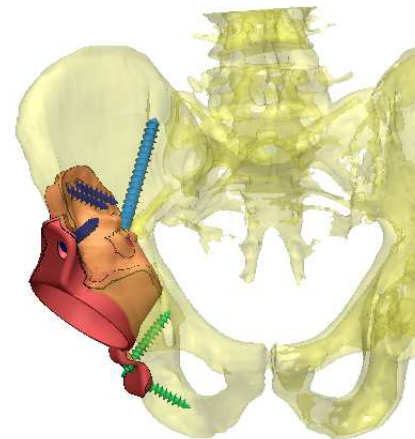
Dr. Maximilian Munsch

Lia Sabrina Schenk

C. Renneberg

2015 distributor meeting

- surgical planning and „conventional“ customized Implants
- 3D planning with different Software platforms
- 3D planned customized implants incl. additive manufacturing
- PSI Patient specific instruments
- Processing of customized implants from planning to delivery
- Development and improvement of process chain
- Biomechanical studies
- Presentations



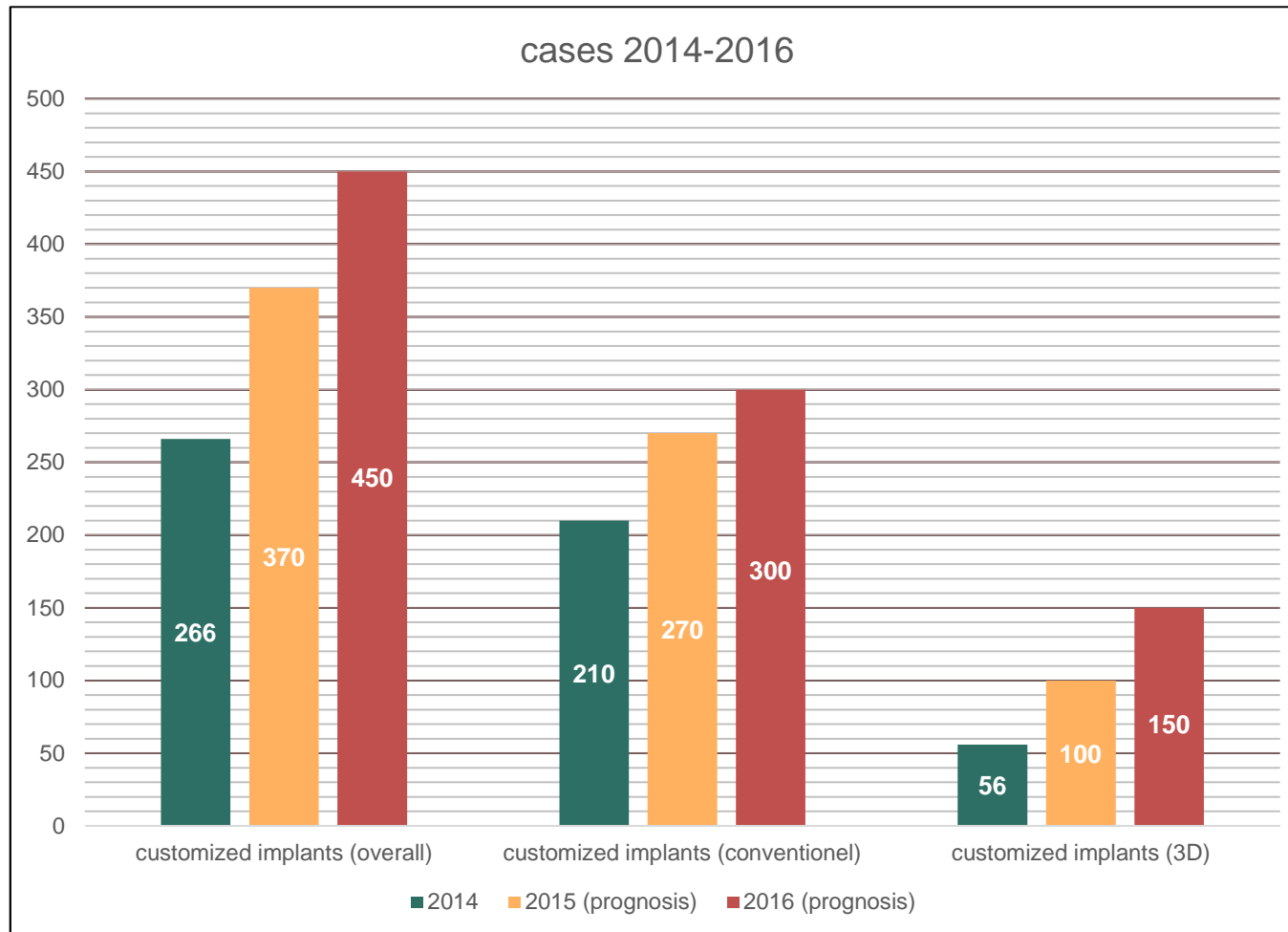
# Team

- **Lia Schenk**  
Primary contact for 3D planned implants
  
- **Gunnar Erb**  
Primary contact for planning and conventional customized implants
  
- **Frederik Albers**  
Currently in training  
After reaching his Bachelor degree in January 2016 he will start full-time to complement the team

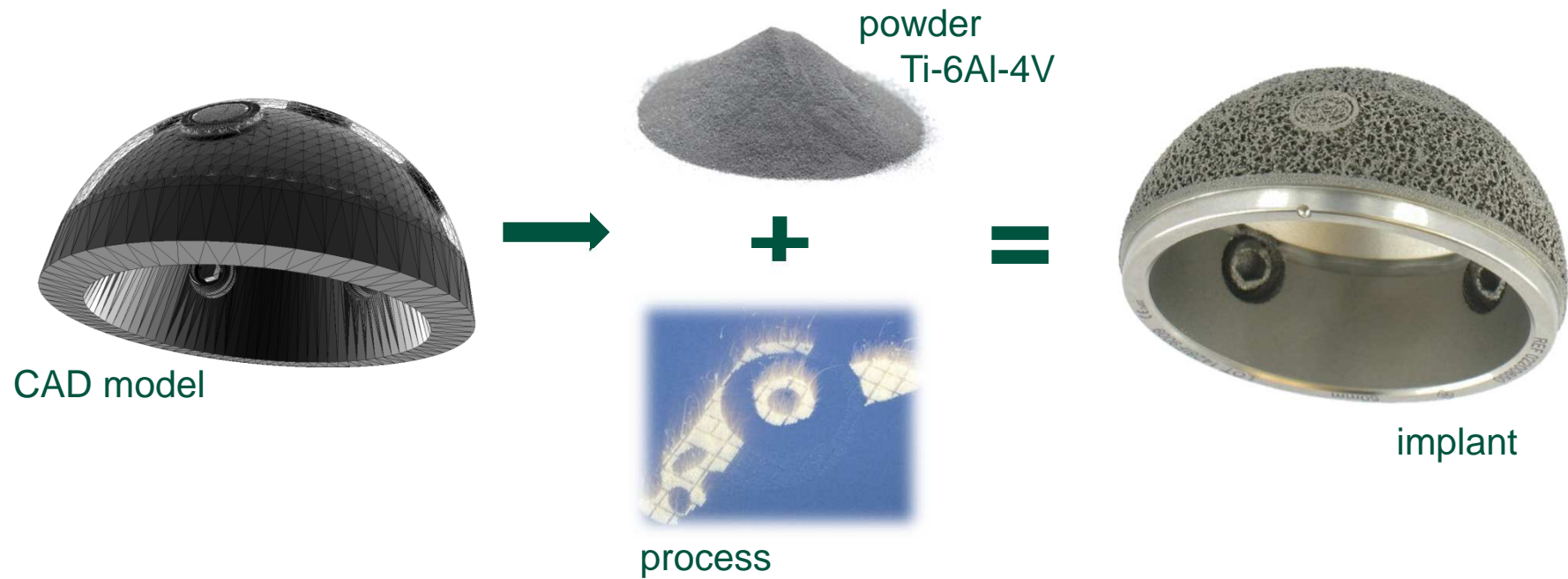
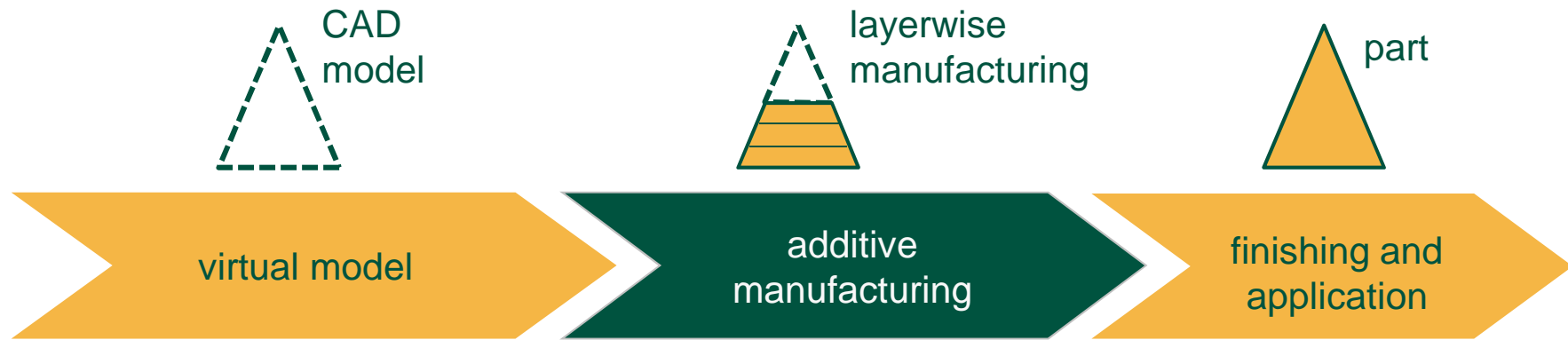


# Capacities

## Customized implants 2014/2015/2016



# Additive Manufacturing (3D printing)

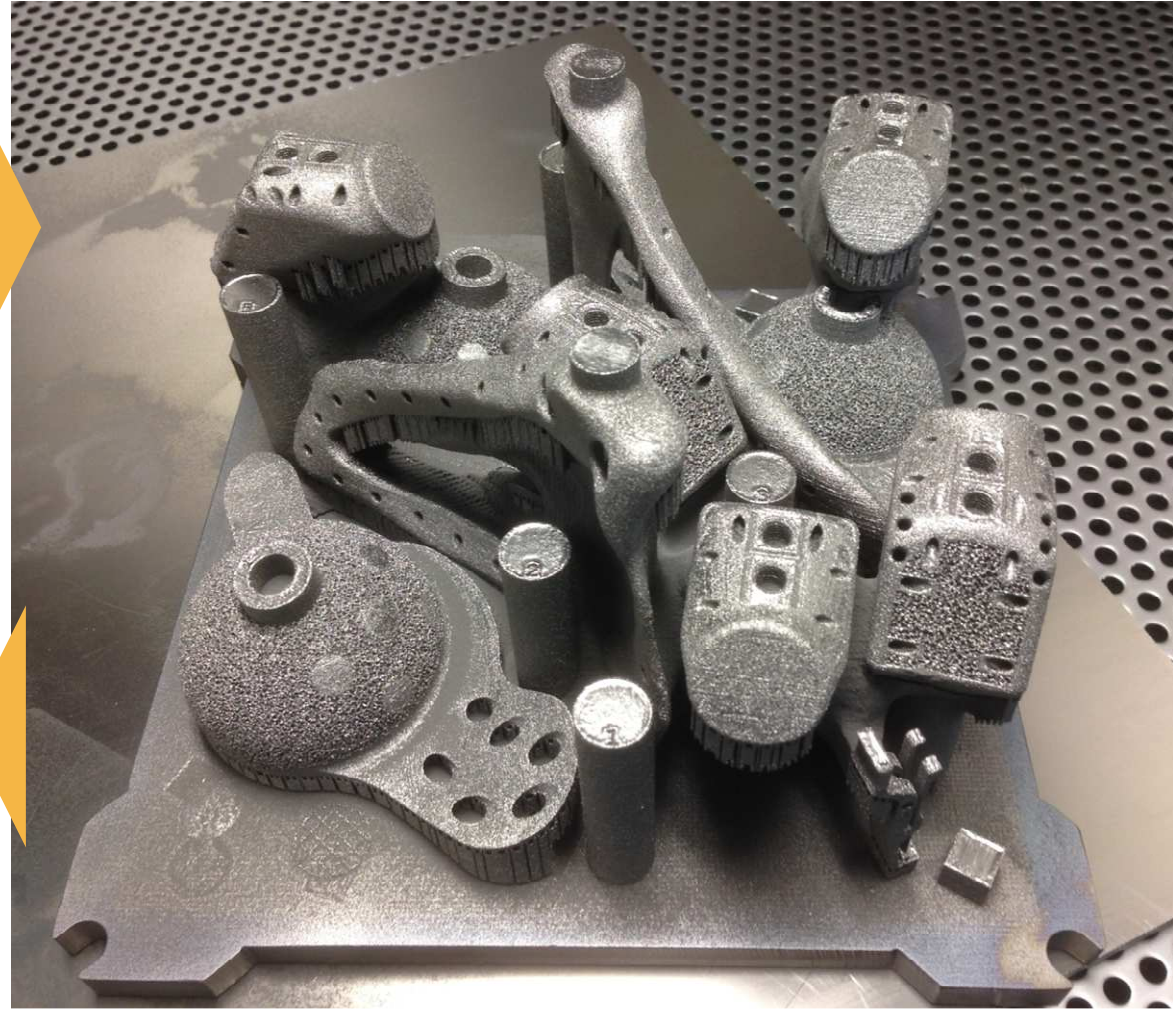
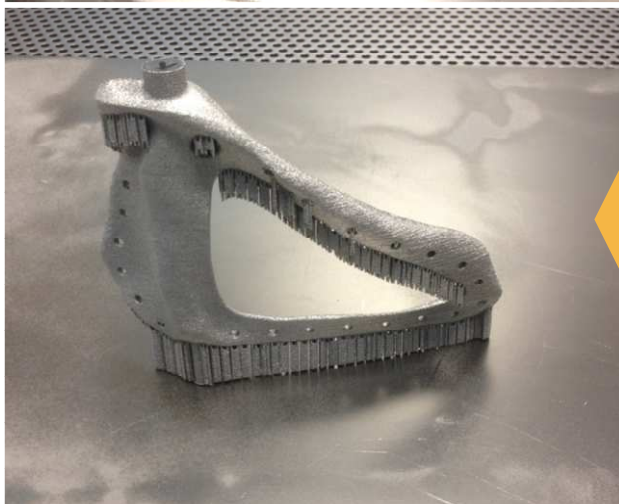


# Process of Additive Manufacturing: Electron Beam Melting (EBM)



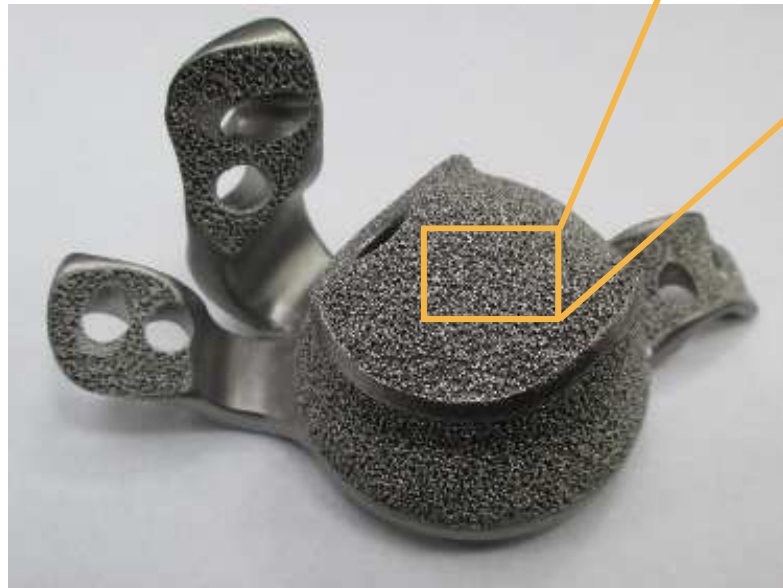
- ❖ selective melting of powder
- ❖ layer height 50  $\mu\text{m}$
- ❖ Ti-6Al-4V
- ❖ transfer of kinetic energy from electrons

# Post processing of additive manufactured implants



# EPORE® porous osseointegrative structure

- ❖ stochastic open-cellular structure
- ❖ application at bone-implant-interface
- ❖ part of implant geometry, not a surface coating

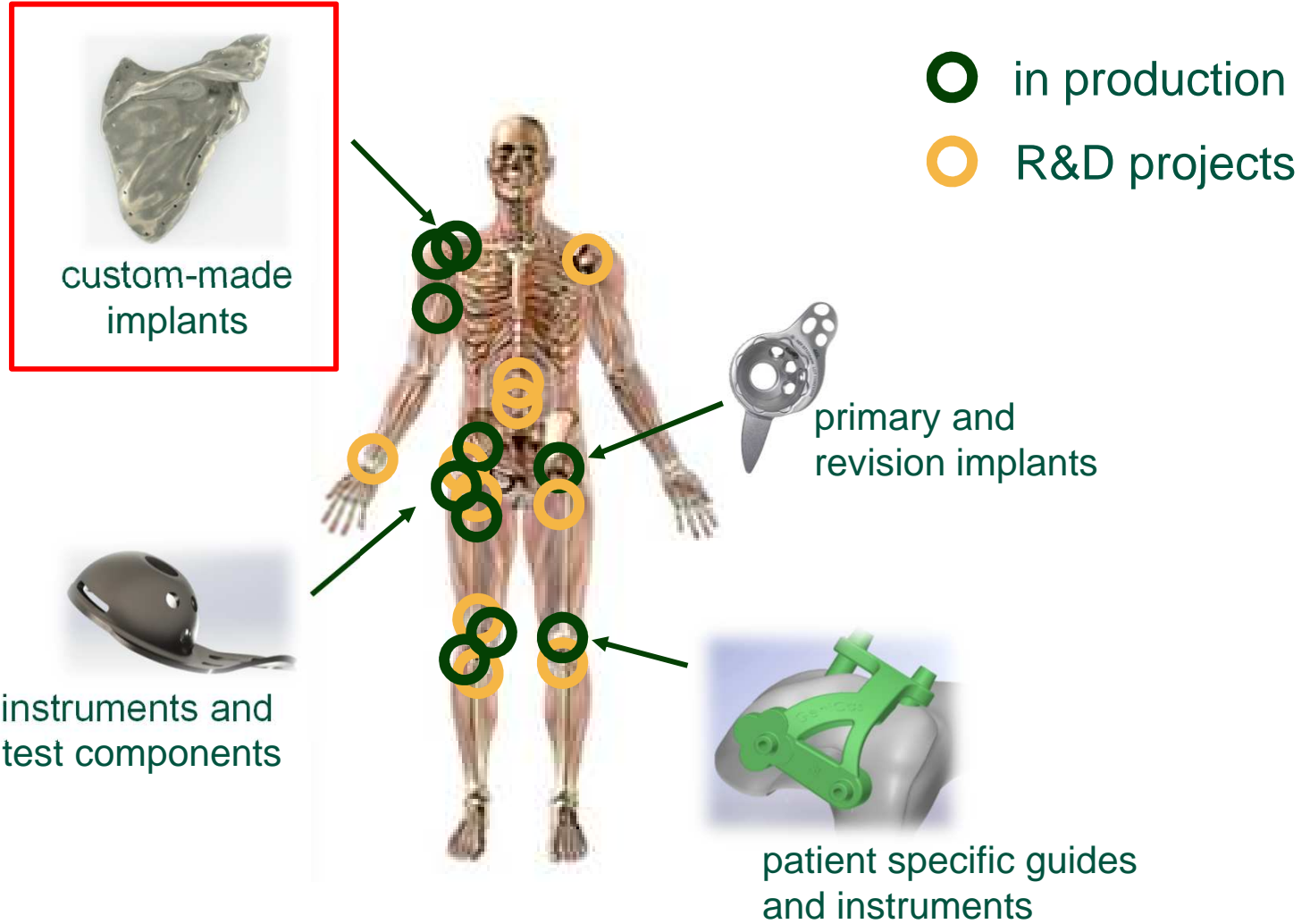


❖ properties in comparison:

	cancellous bone	EPORE®
porosity	30-90%	60%
trabecula	0,1-0,2 mm	0,33-0,39 mm
spec. Young's modulus	0,5-5 GPa	3 GPa*

\*tensile measurement

# AM product portfolio



# Examples of additively manufactured custom-made implants

glenoid/  
scapula  
replacement



distal component  
humerus inverse



ilium replacement



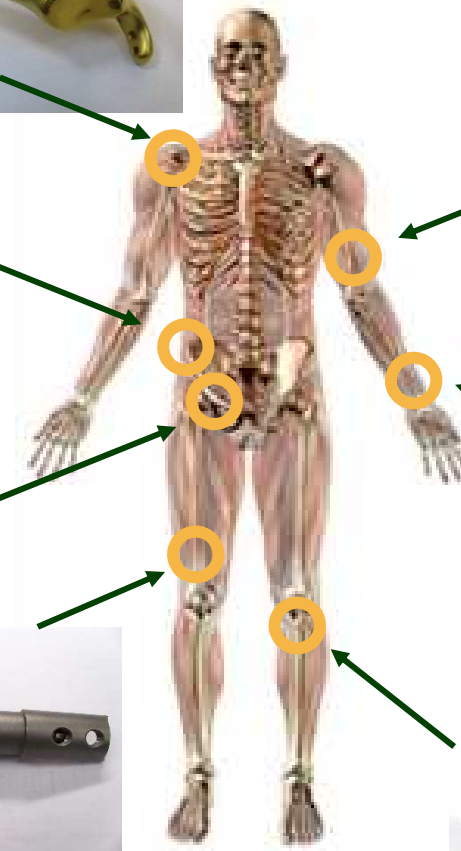
distal  
radius

hip  
replacement

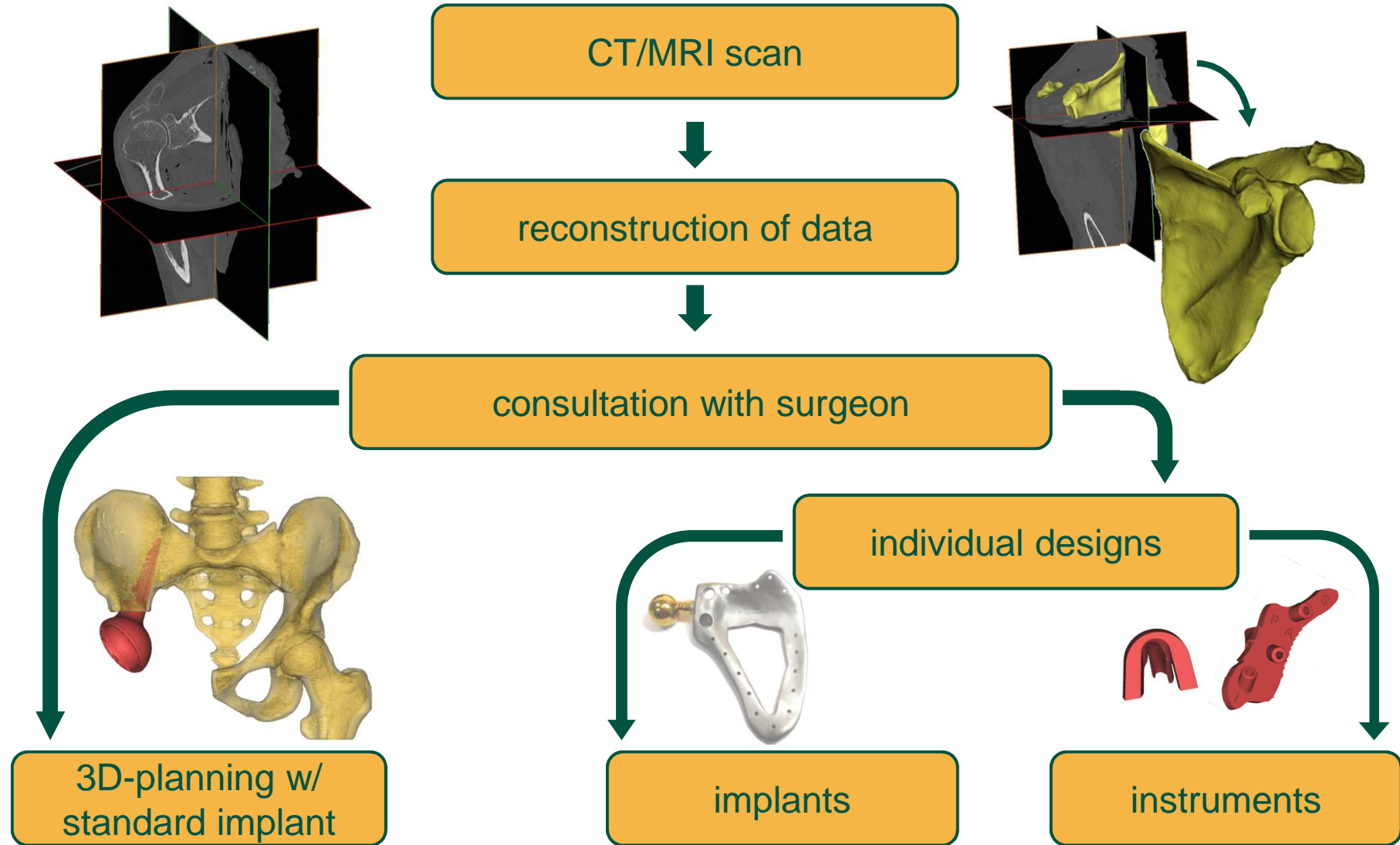


diaphysis component

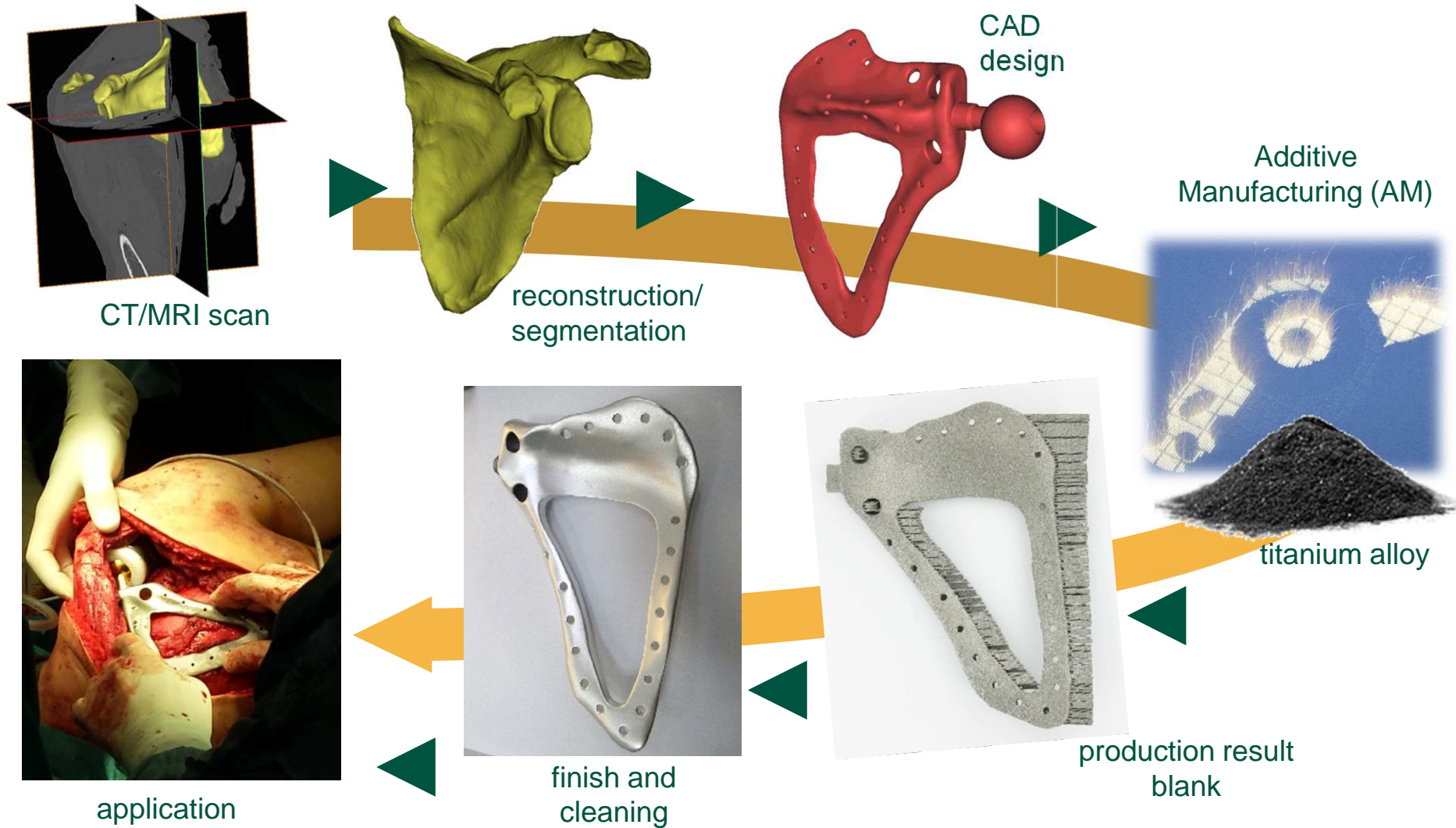
spacer and  
sleeves



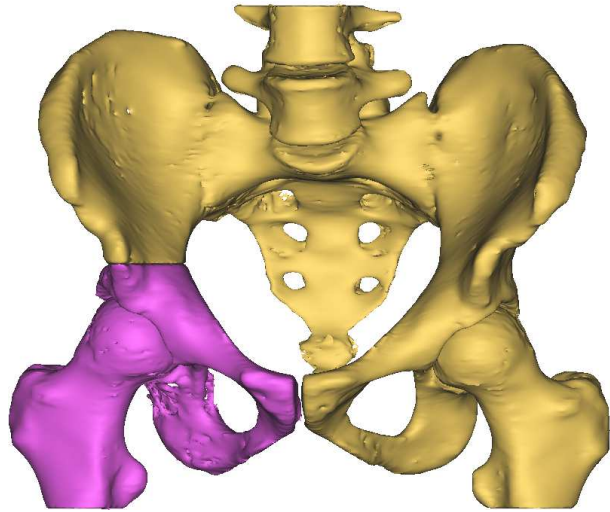
# Process of 3D-planning of standard and custom-made implants



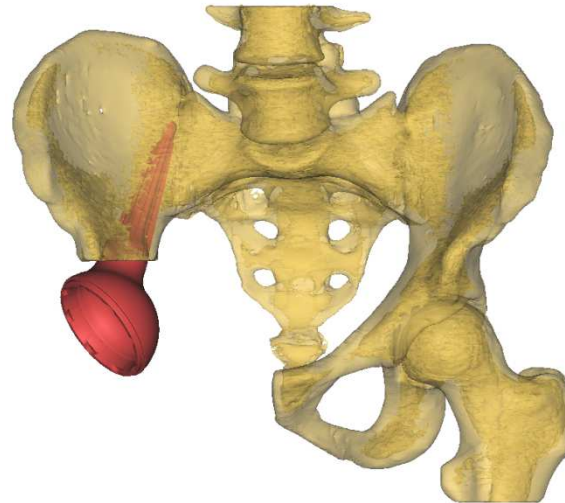
# Additive Manufacturing process chain for custom-made implants



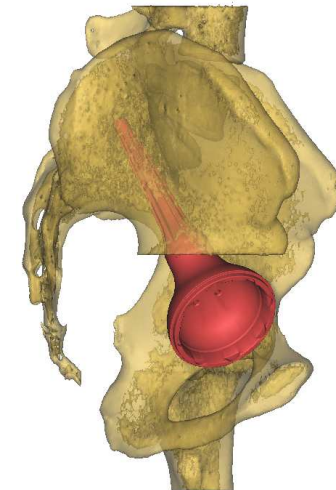
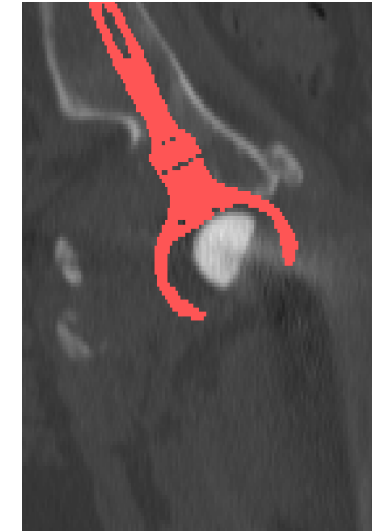
# 3D Planning of surgical procedure



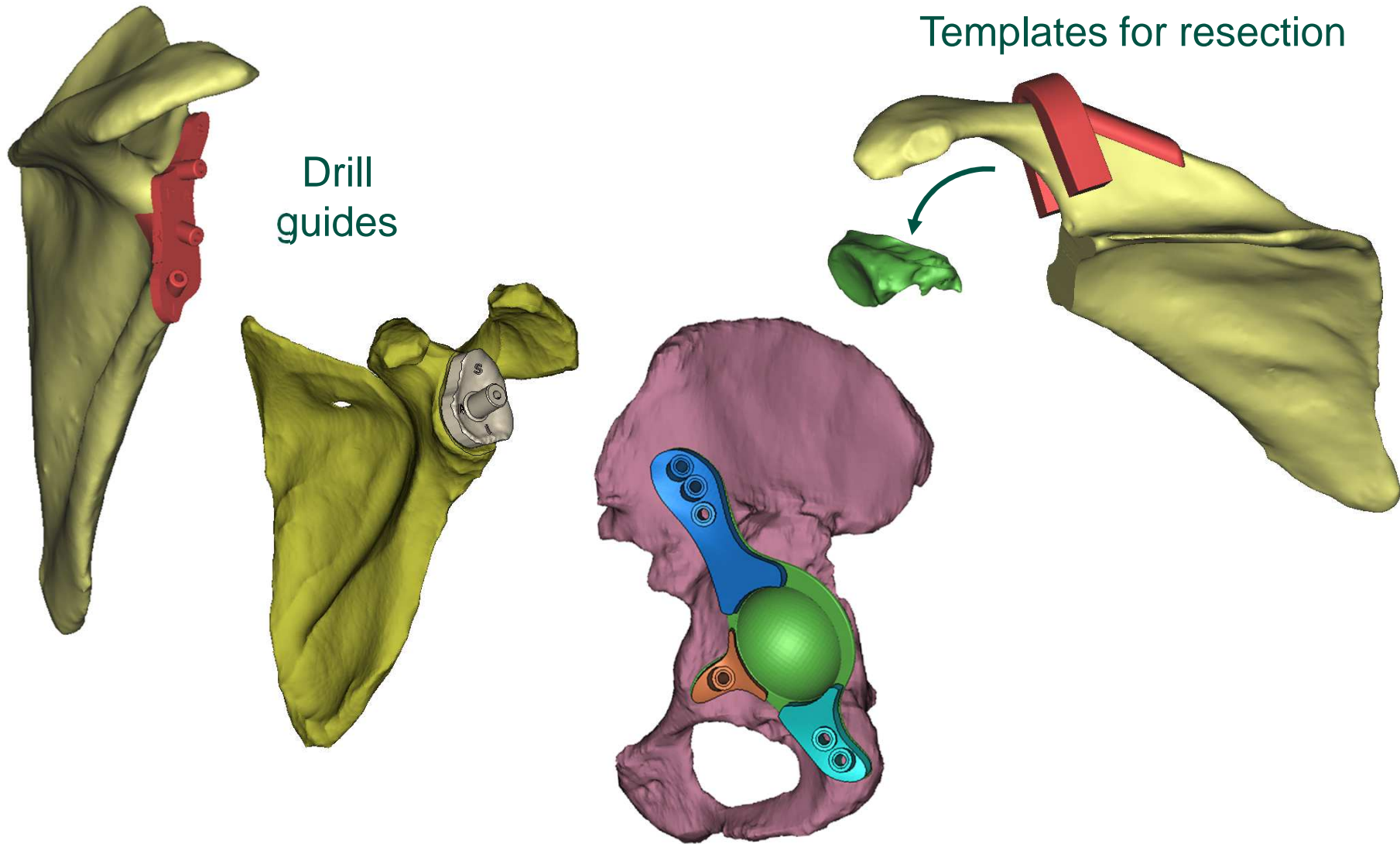
virtual resection



implant "in place"

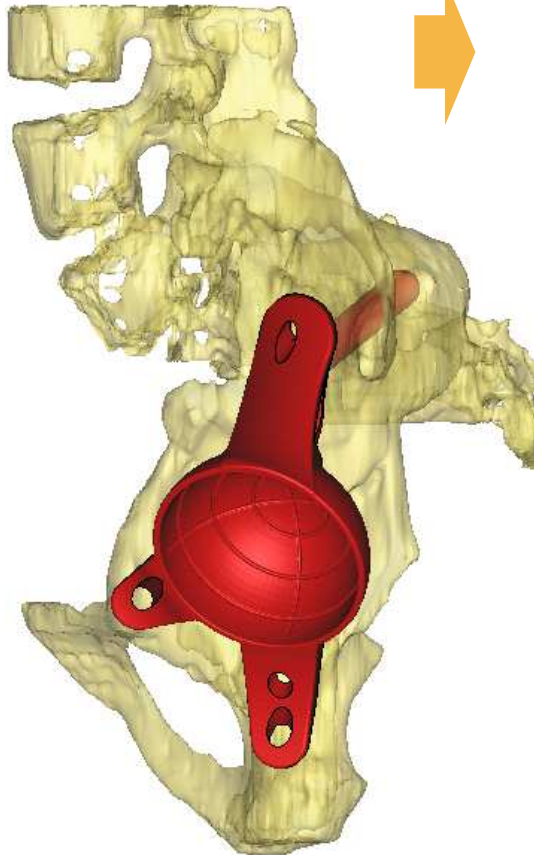


# Design of custom made drilling and saw guides

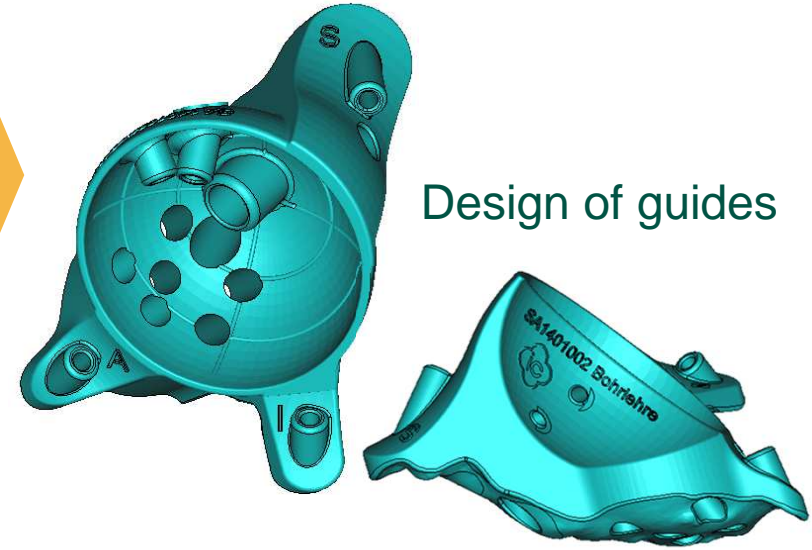
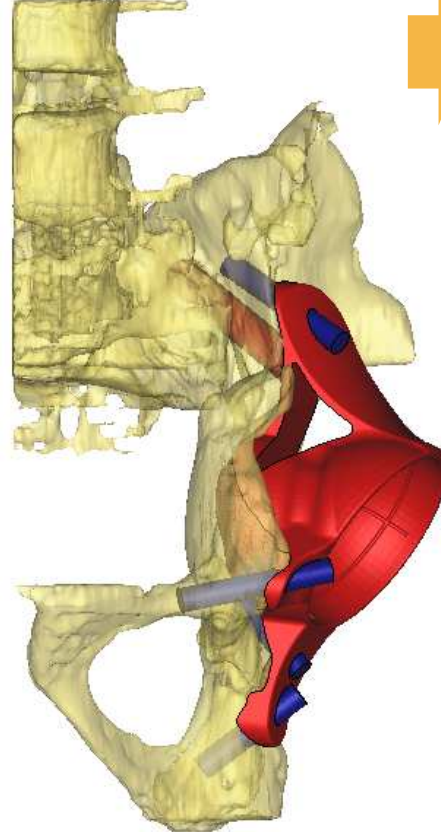


# Design of custom implant

Design of stem and shell

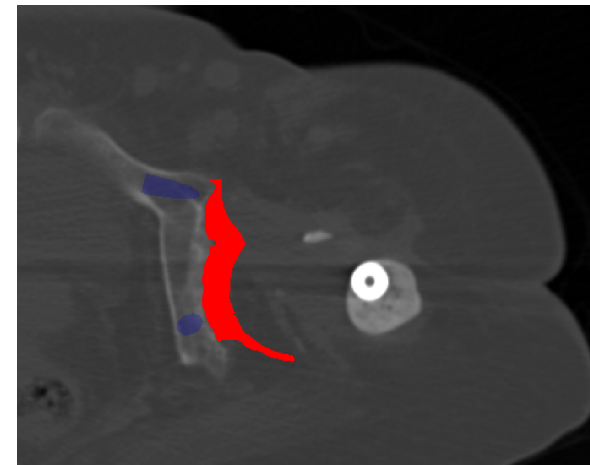


Design of screw length and direction

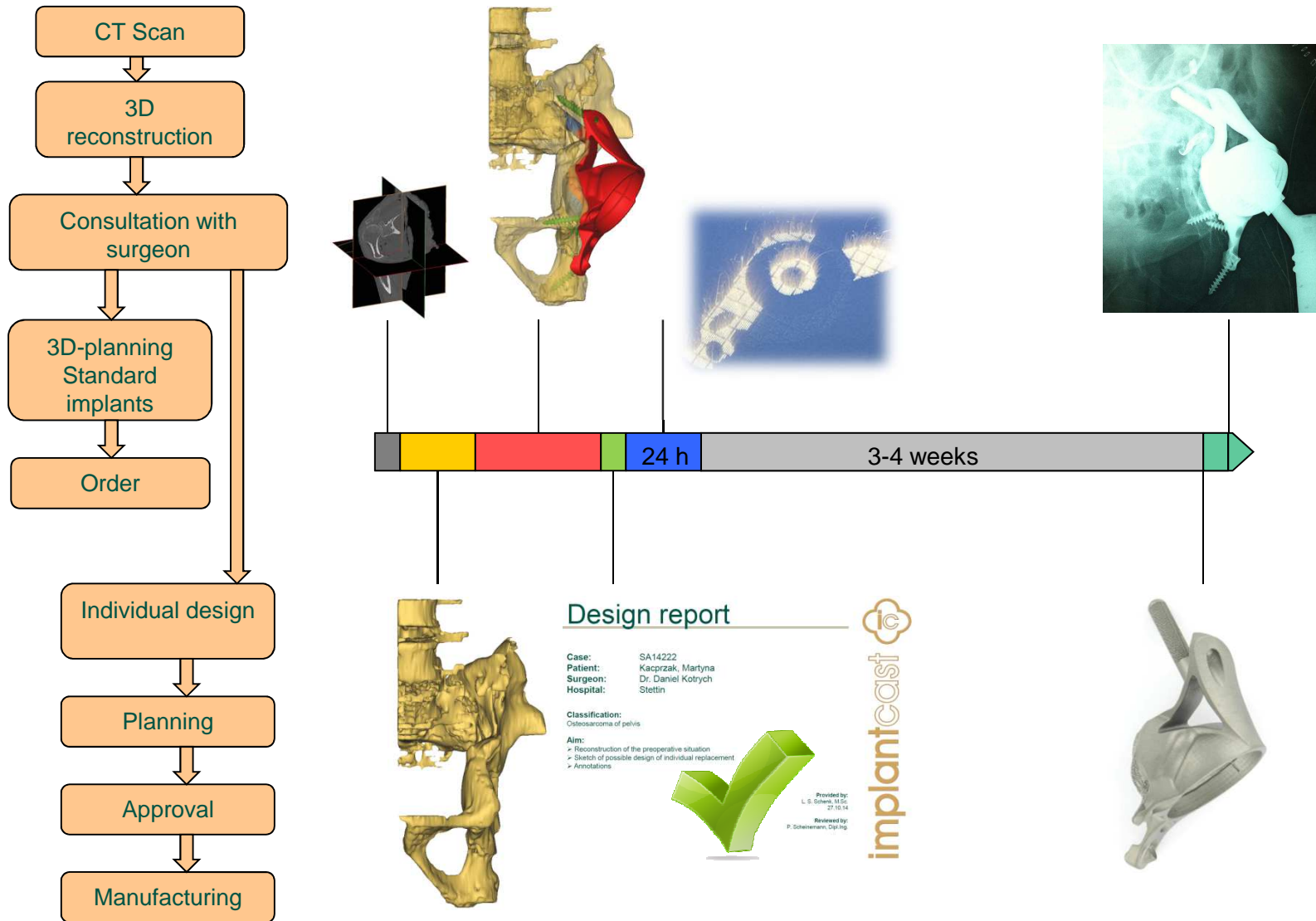


Design of guides

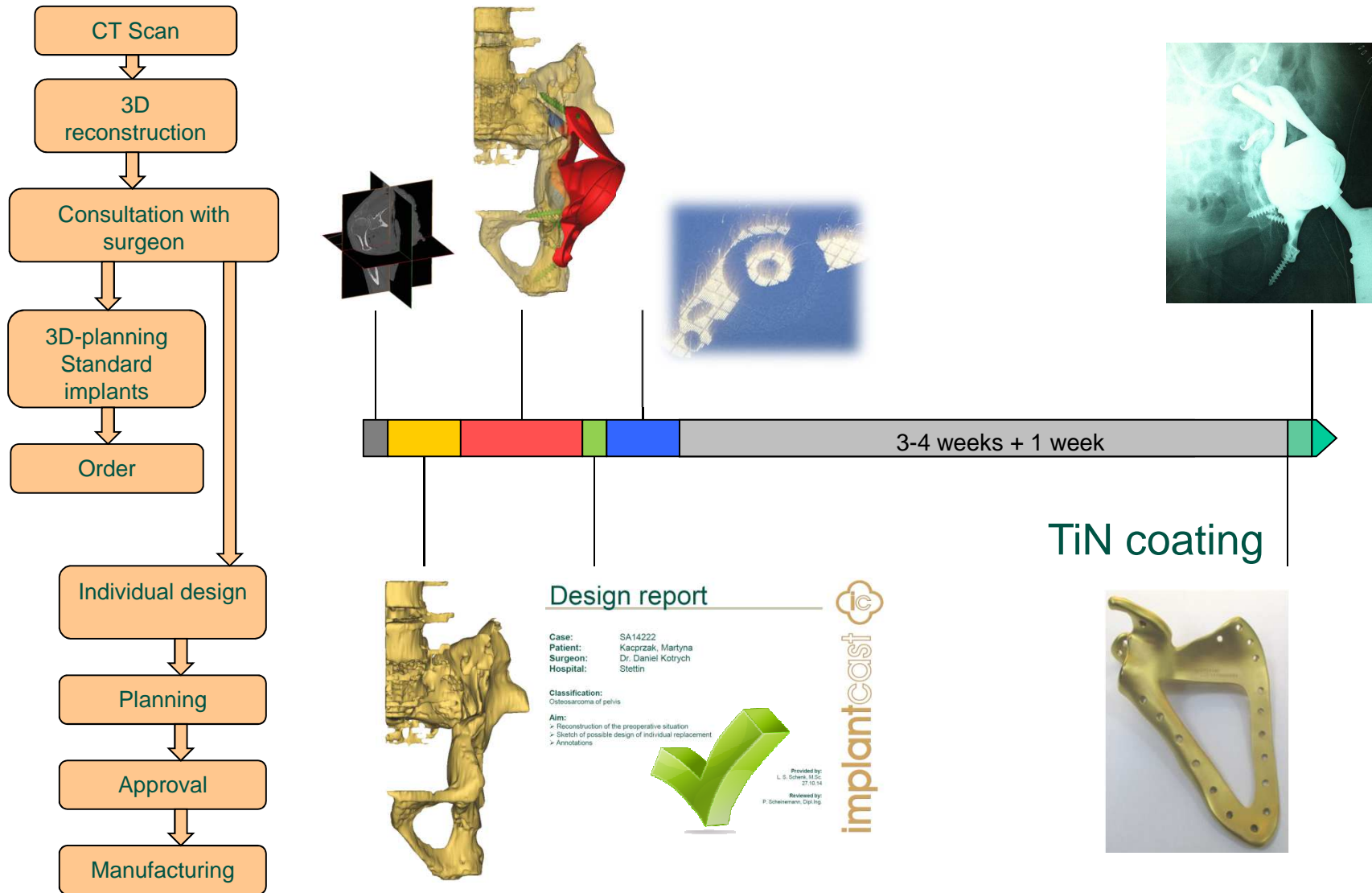
direct control



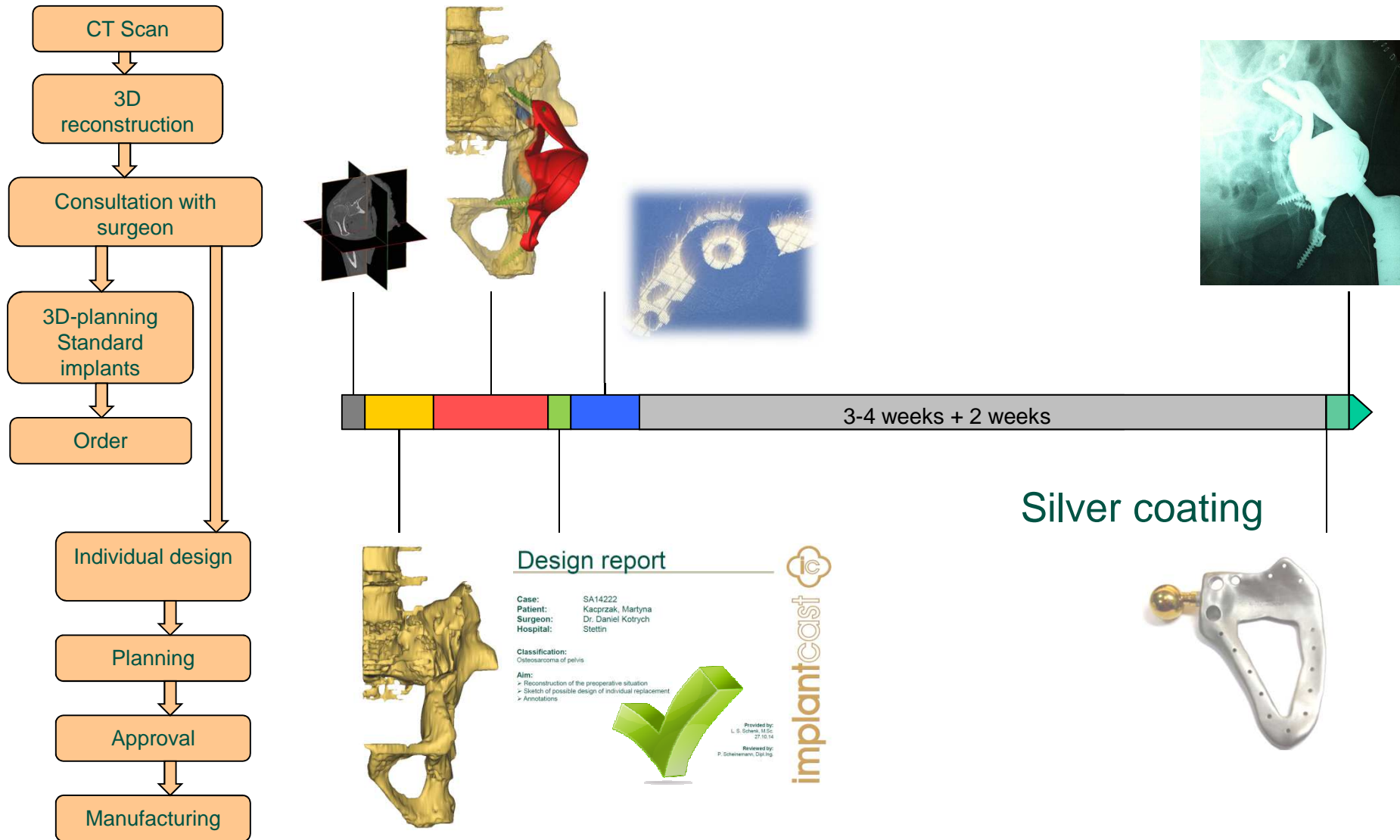
# Exemplary process



# Exemplary process



# Exemplary process



# Custom-made implant required?

- ❖ Contact C-Fit 3D team at implantcast
  - C-Fit 3D - customized implants and instruments
  - cfit3d@implantcast.de
  
- ❖ Send us
  - Patient information and medical indication
  - Case description
  - In tumor cases resection level!
  - for 2D planning **x-ray** (scaled in ML and AP)
  - for 3D planning high resolution **CT data** (MRI in certain cases)
  
- ❖ We plan the case!
  
- ❖ You will receive case information. (Example)

# Case information

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**Example:  
Case information**

**Case:** SA15006

**Patient:** XXX

**Surgeon:**

**Hospital:**

**Classification / Indication:**

Fracture between right Acetabulum and Os Ilium

**Purpose / Therapy:**

⊕ MUTARS® custom made hip replacement with 3 flaps

**Provided by:**

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+49 4161 744 220

31.03.15

**Reviewed by:**

P. Scheinemann, Dipl.Ing.

implantcast

# Case info

**Example:  
Case information**

## Data of patient

**Name:** xxx  
**Gender:** male  
**Age:** 81 years

**Surgeon:**

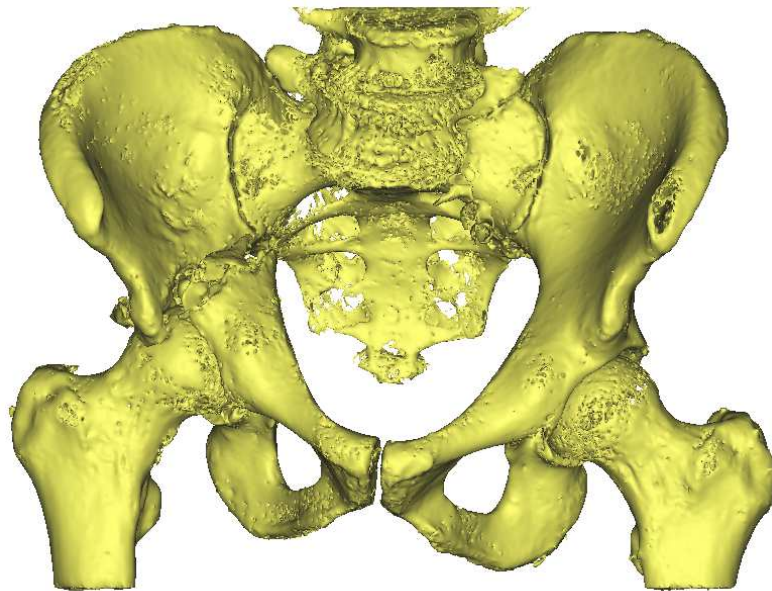
**Hospital:**

## Case

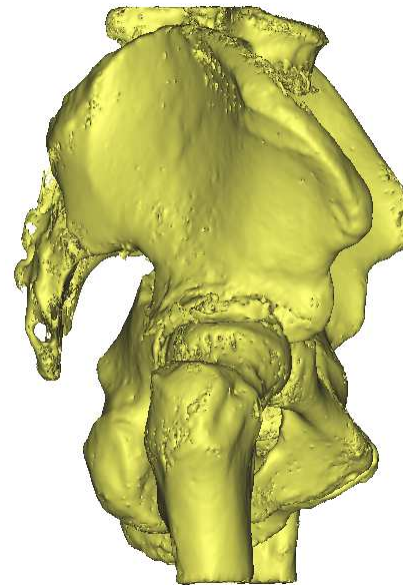
**Case announced:** 13.01.2015  
**CT data:** 13.01.2015  
**Surgery date:** ...

# 3D-Reconstruction

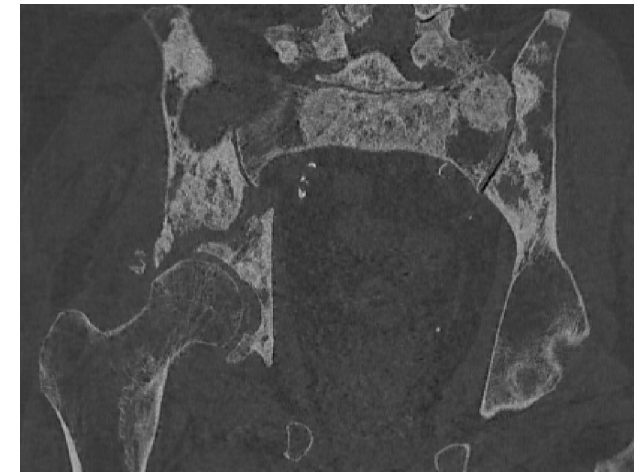
**Example:  
Case information**



Front view

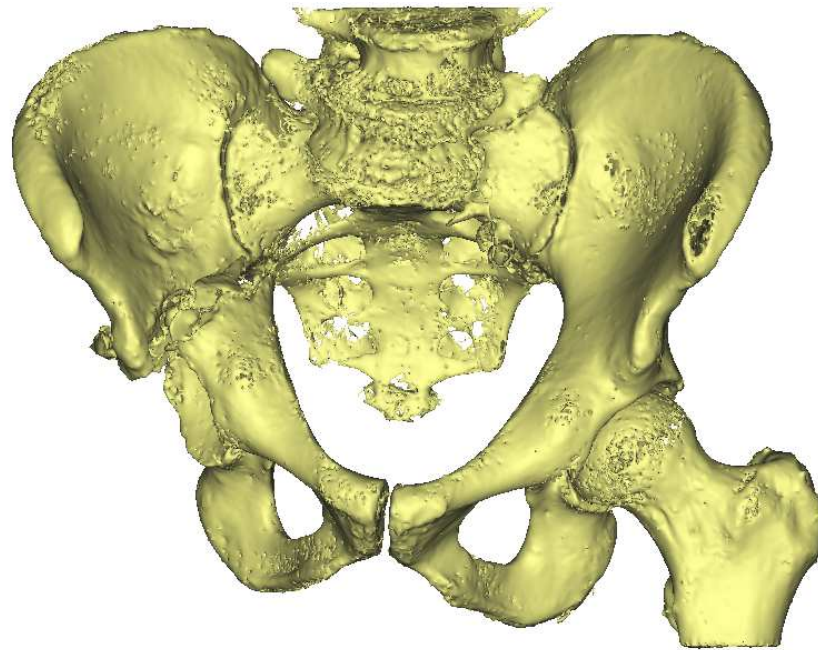


Right view

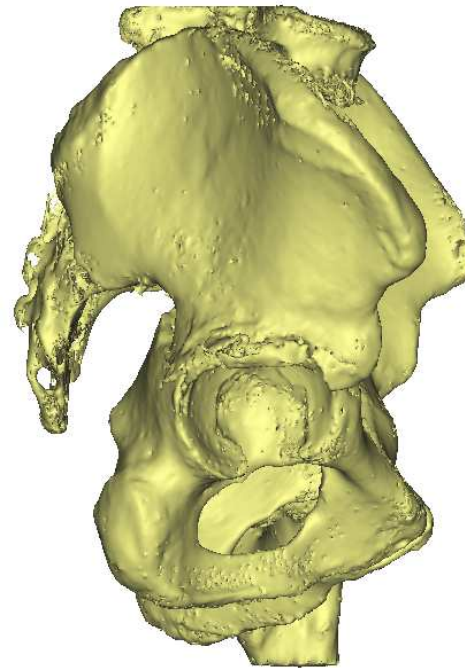


CT

# 3D-Reconstruction without right femur

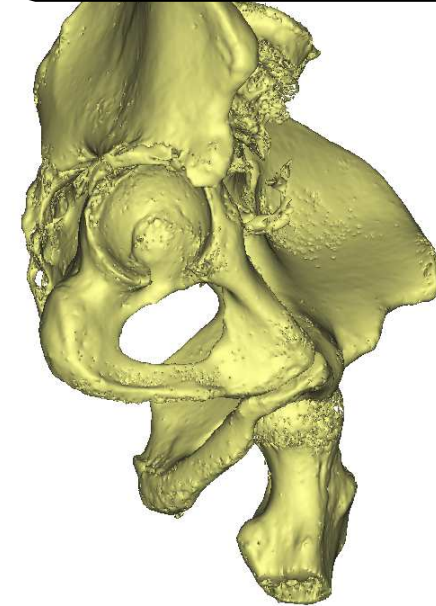


Front view



Right view

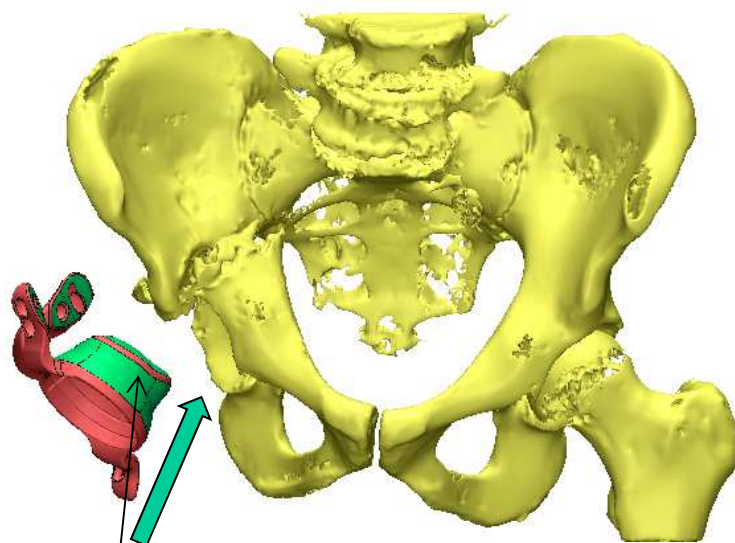
**Example:  
Case information**



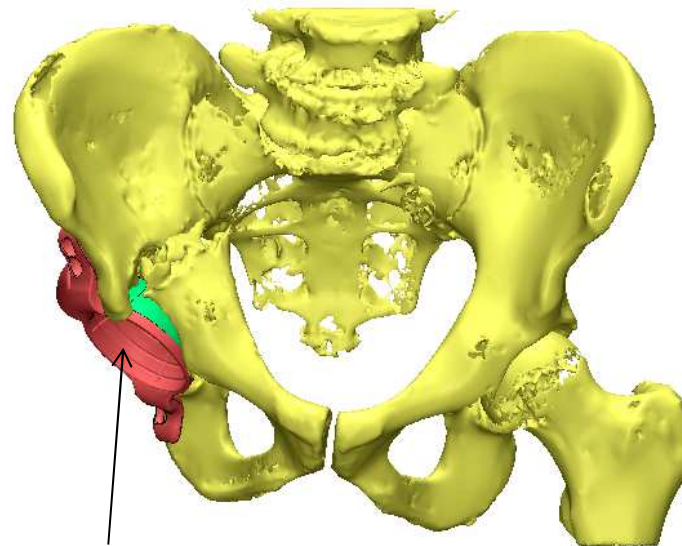
# Implant positioning

Placing the implant into the defect

**Example:  
Case information**

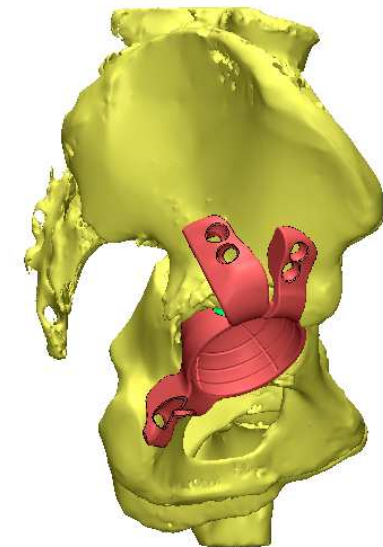


Porous structure



Cup size  $\text{\O}52/57\text{mm}$  for cementing a cup  $44/50\text{mm}$

Front view



Right view

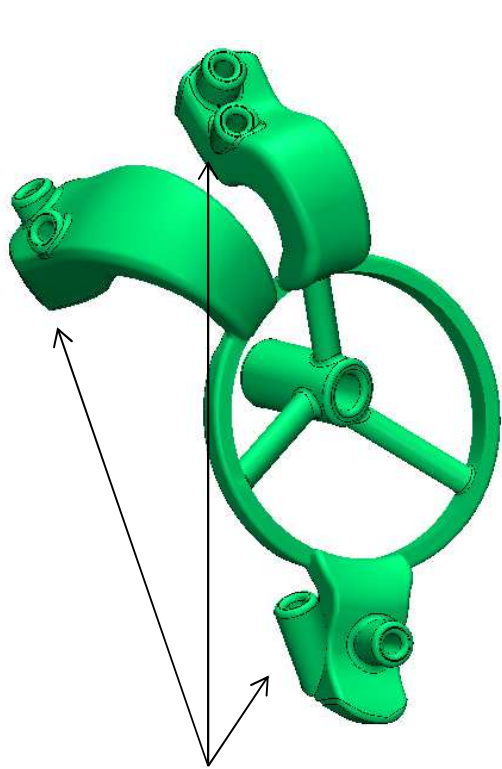
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- ❖ We plan the case!
  
- ❖ You will receive case information.
  
- ❖ **After acceptance and confirmation we prepare surgical guidance and start production.** (Example)

# Use of PSI drill guide

Place the PSI onto the cup edge and the flaps

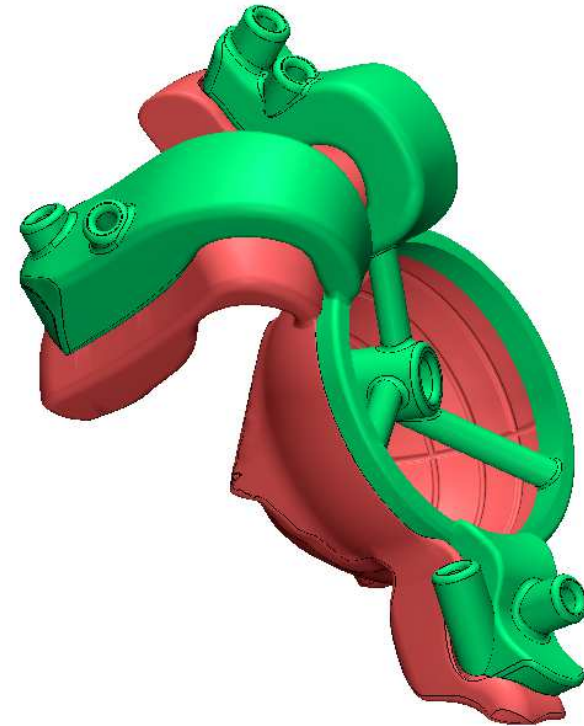
**Example:  
Surgical guidance**



6 holes for Ø3,2mm drill



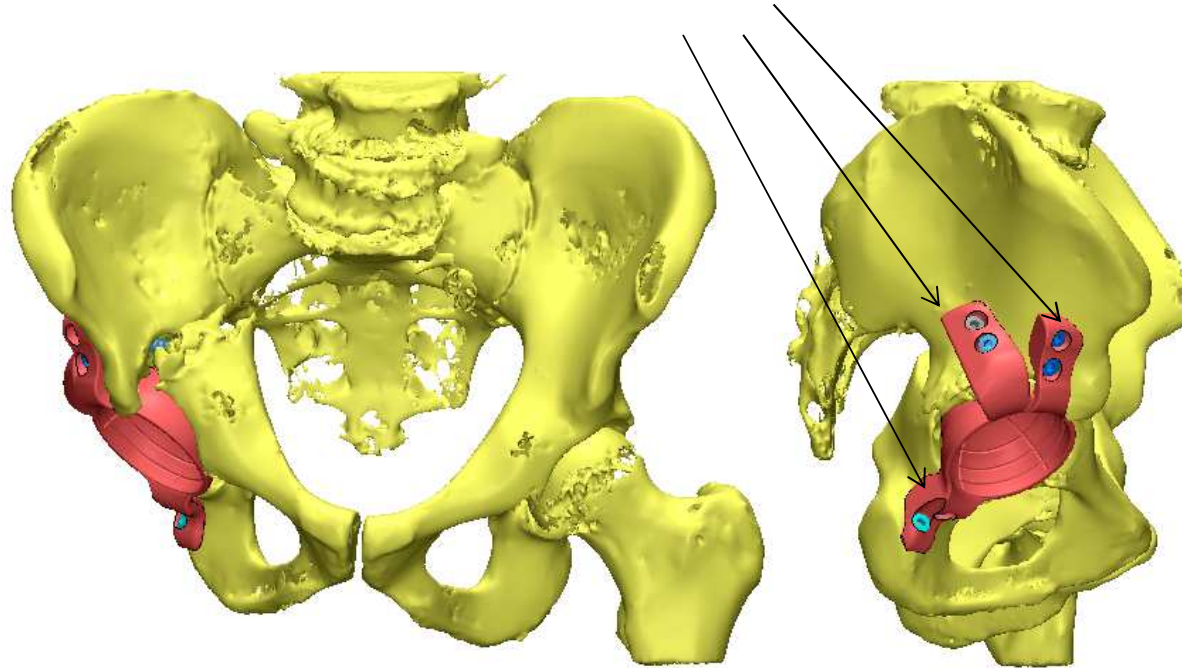
1 hole for Ø6mm drill



Positioned onto the implant

# Screw fixation

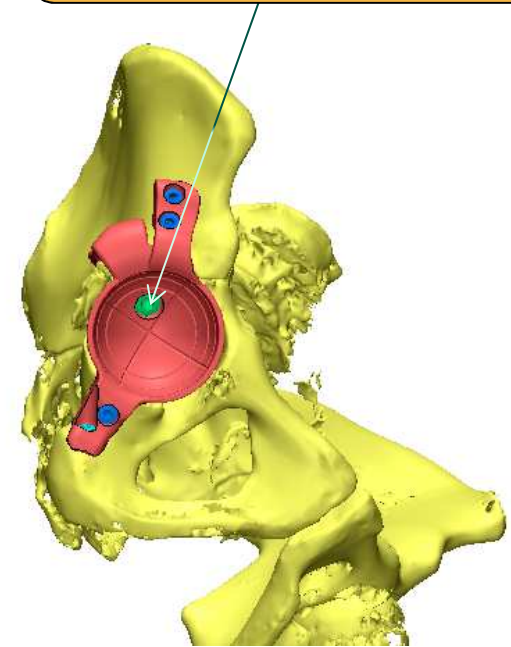
3 flanges fixed with 6 screws Ø6,5mm



Front view

Right view

**Example:  
Surgical guidance**

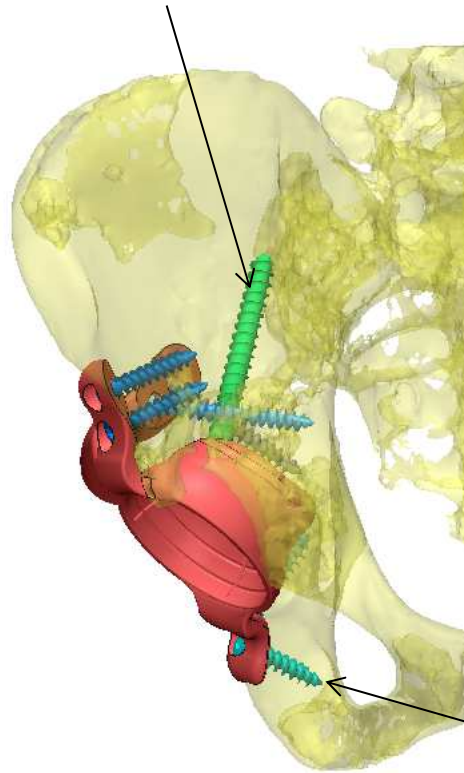


# Screw fixation (transparent)

Ø8x70mm screw

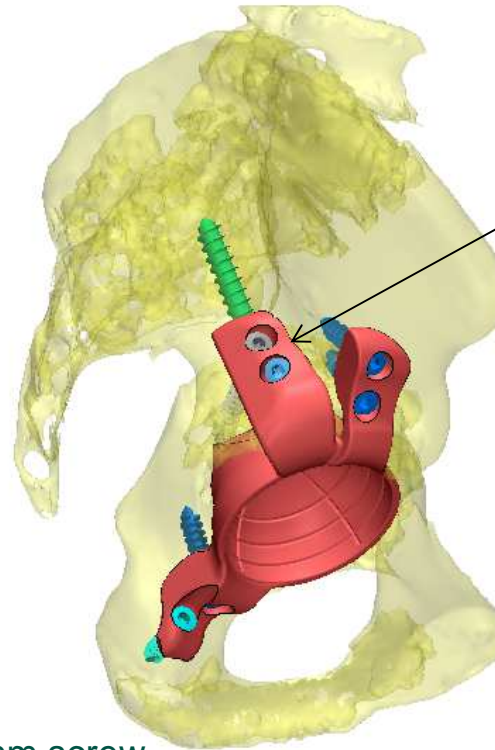
3x Ø6,5x35mm screws  
(dark blue)

**Example:  
Surgical guidance**

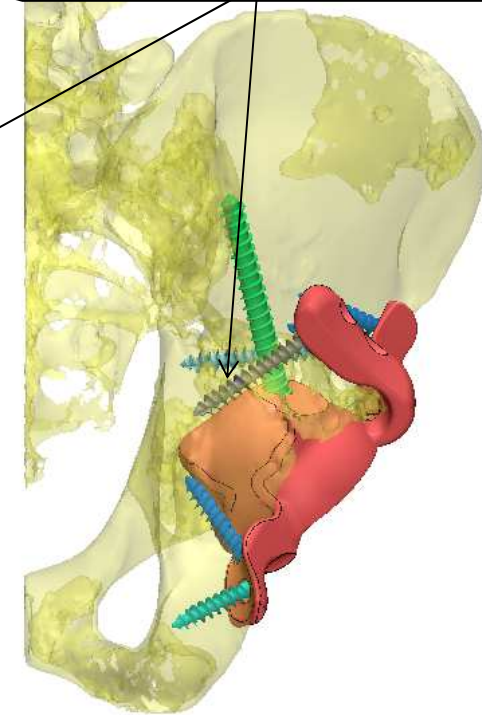


1x Ø6,5x30mm screw

Front view

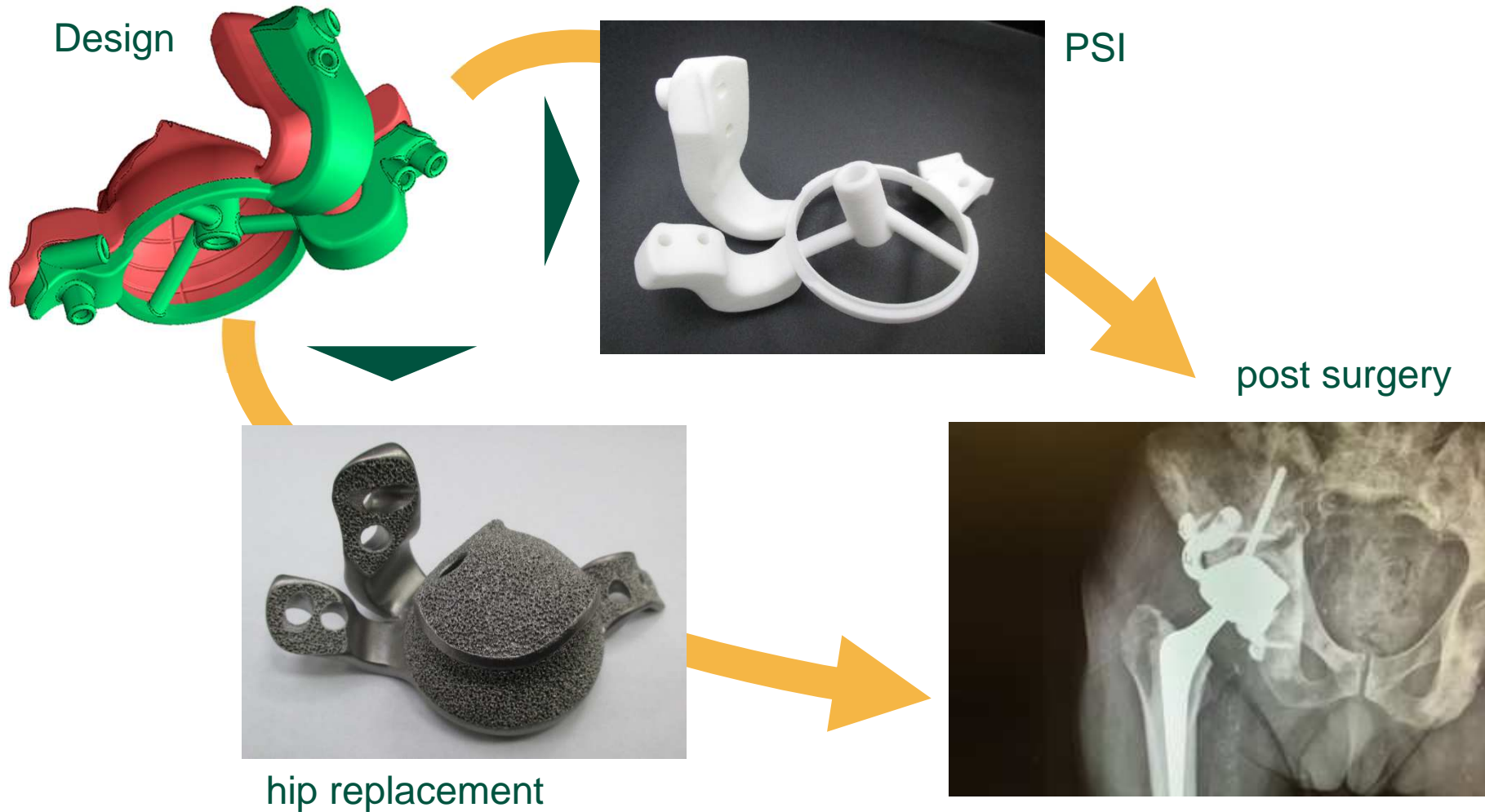


Right view



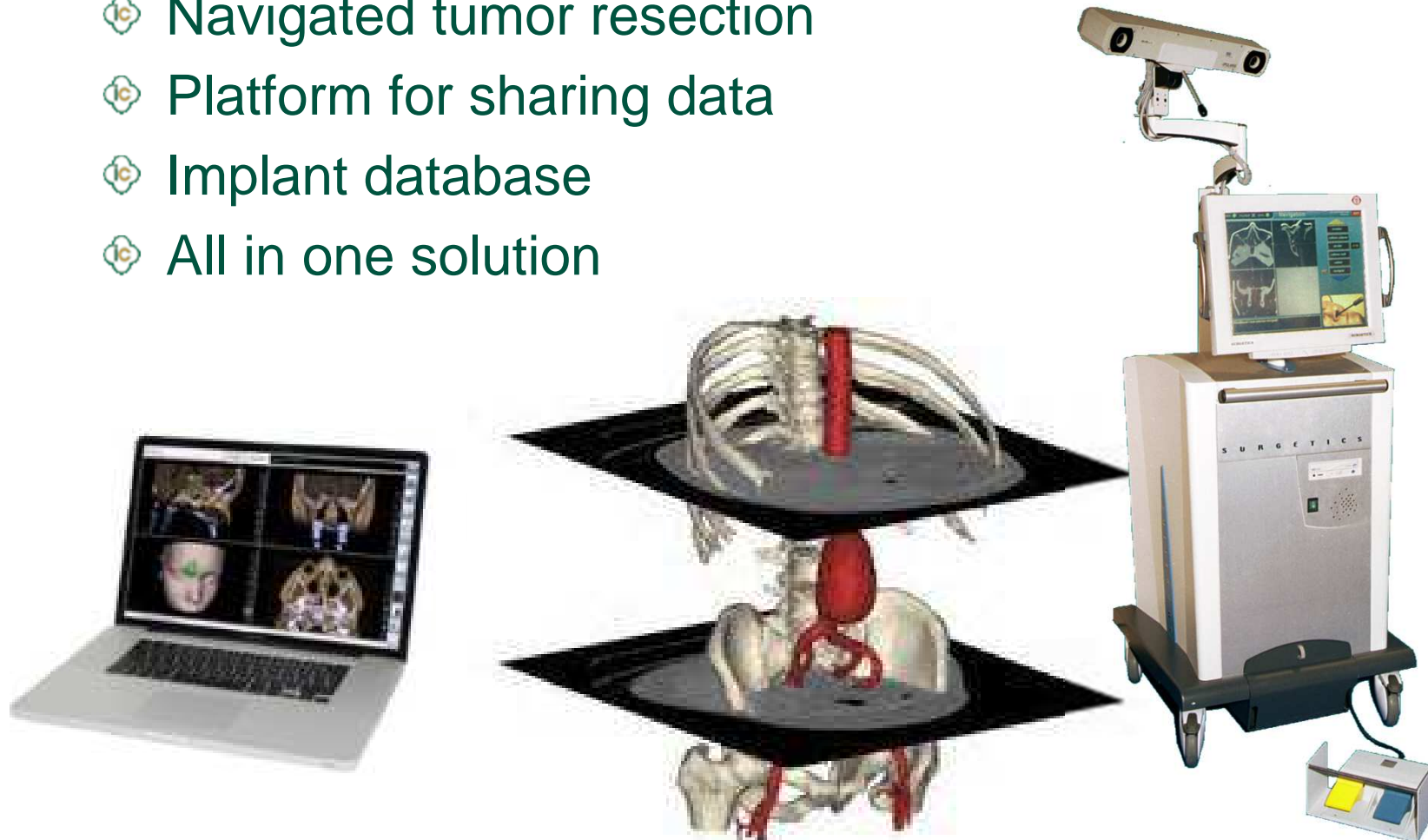
Back view

# Summary: MUTARS® custom made acetabular replacement with 3 flanges

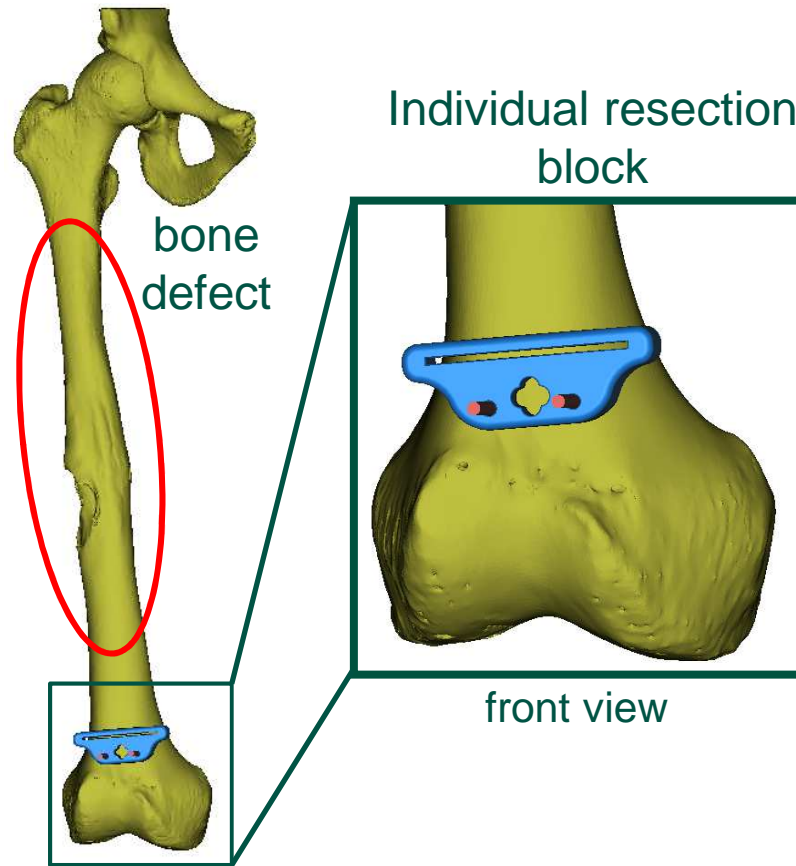


# .....the future

- ❖ 3D oncological planning combining MRI/CT
- ❖ Navigated tumor resection
- ❖ Platform for sharing data
- ❖ Implant database
- ❖ All in one solution

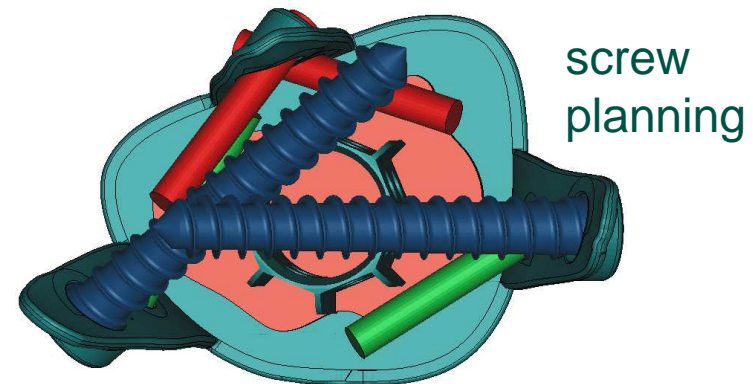
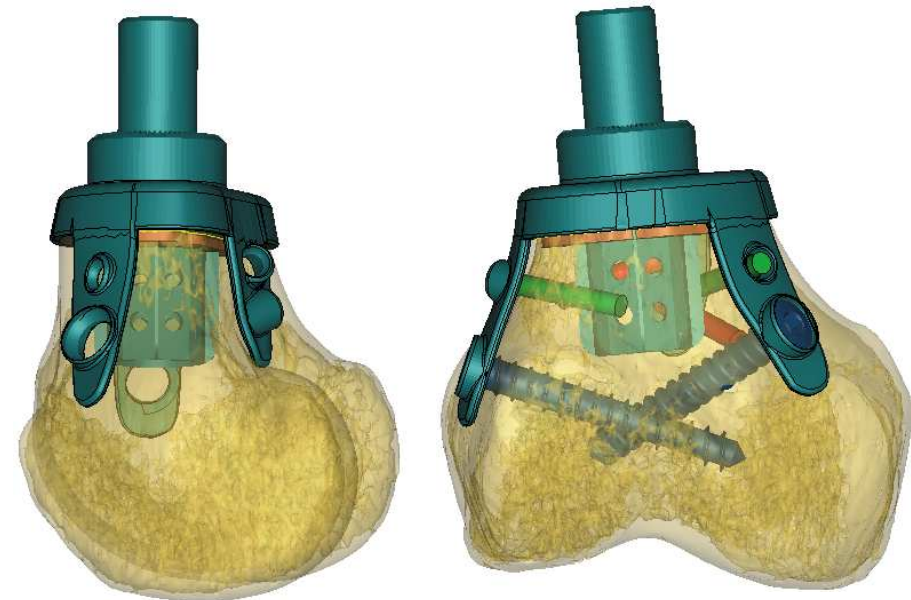


# Case study – knee saving implant



Dr. Sander Dijkstra,  
LUMC Leiden, NED

Individual implant design with  
standard MUTARS® interface



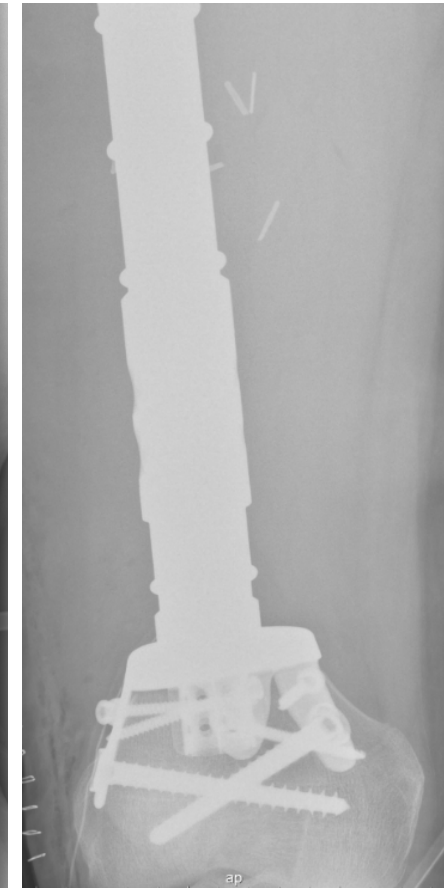
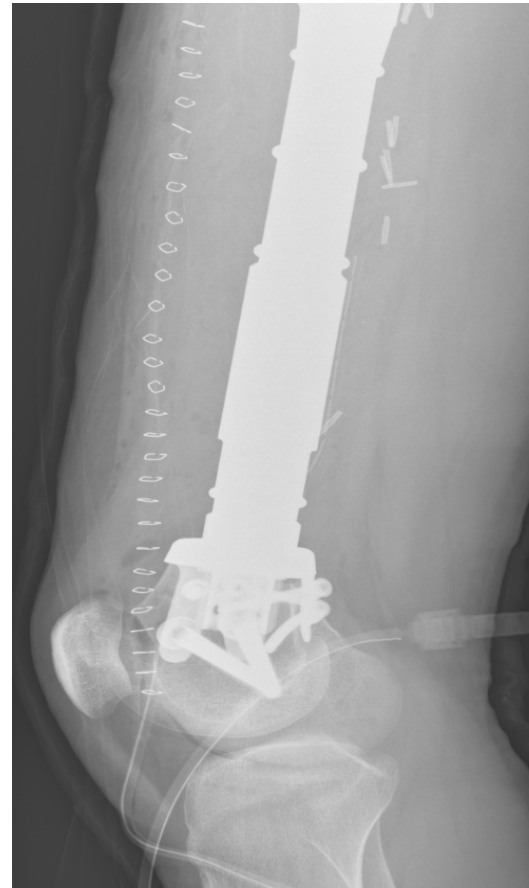
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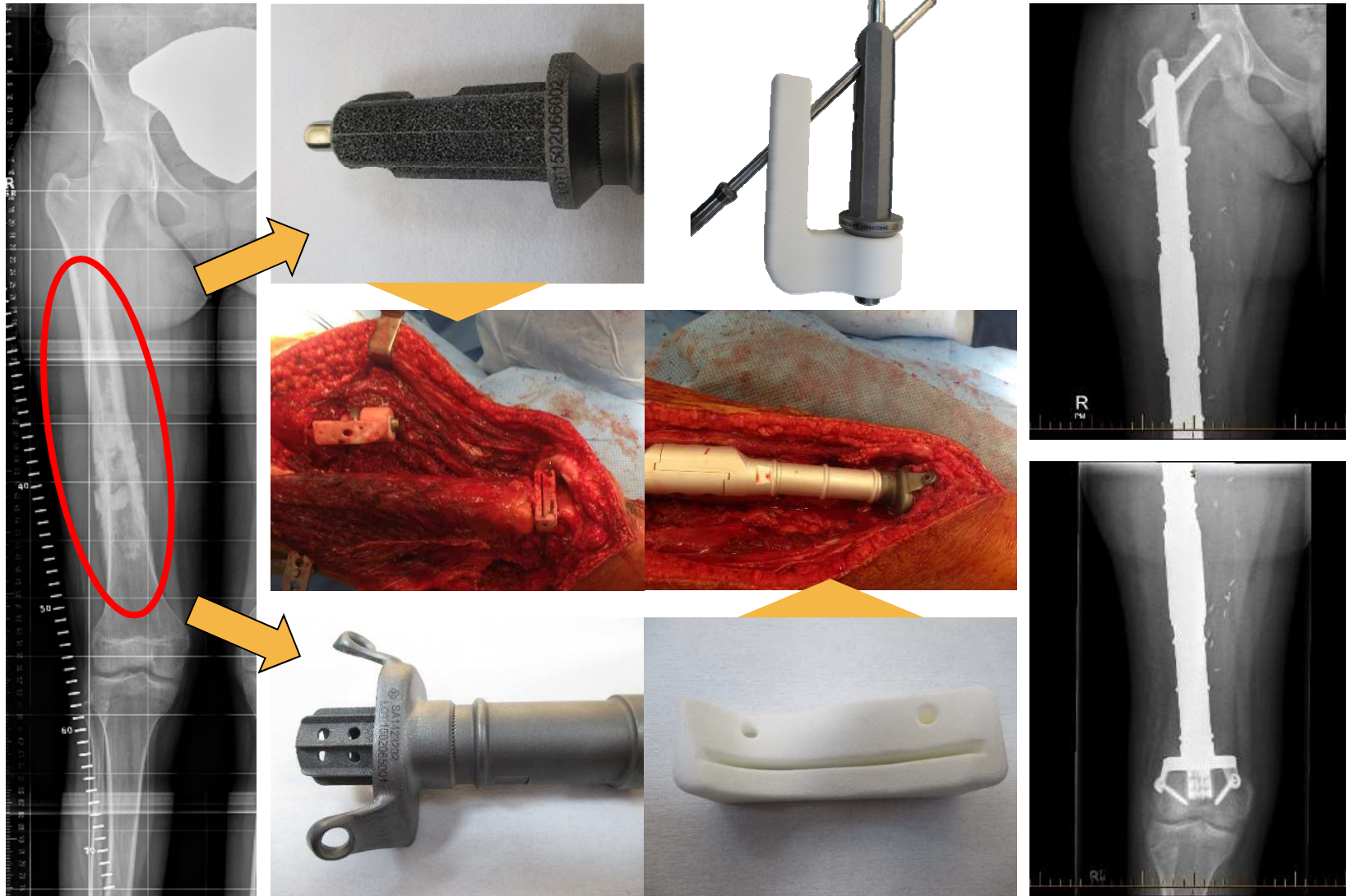


Dr. Sander Dijkstra,  
LUMC

Surgery 07.04.2014



# AM custom-made implant: Diaphysis and Buxtehude stem





**Contact:**  
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**[p.scheinemann@implantcast.de](mailto:p.scheinemann@implantcast.de)**

