Preoperative planning
DO WE NEED IT?

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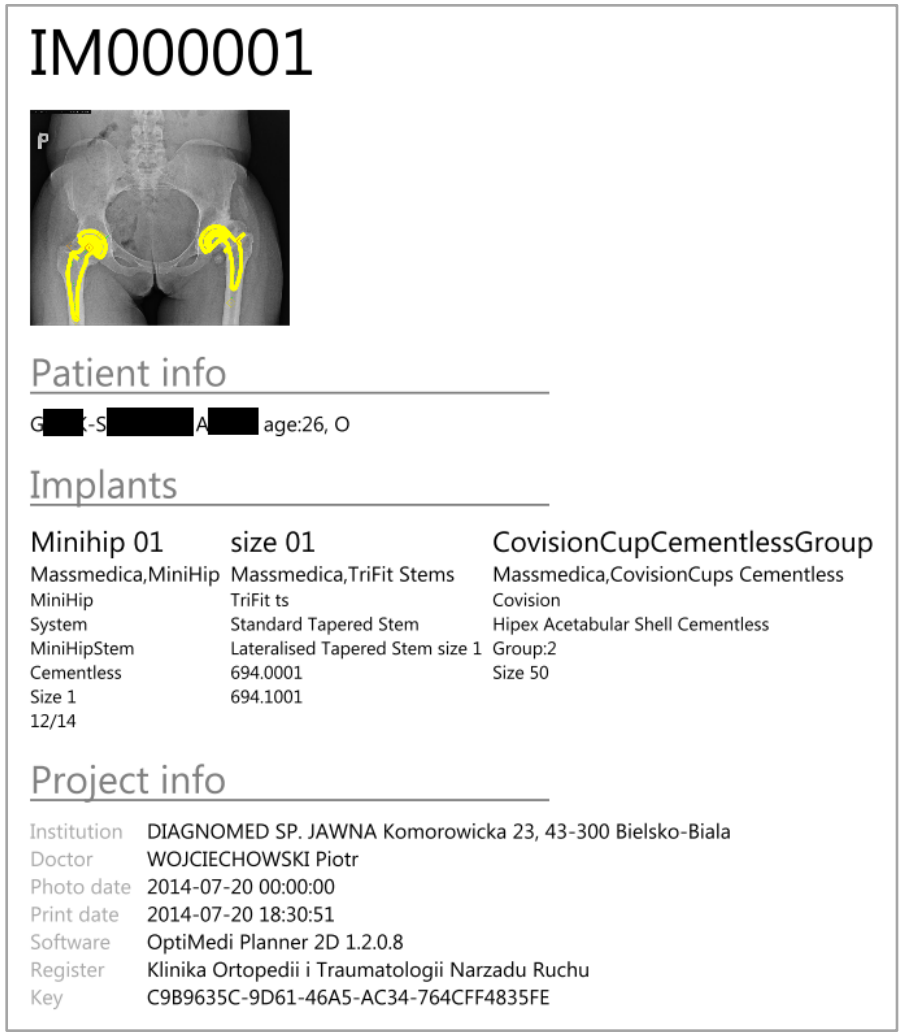
- How to get leg lenght equality after THA ?
- Whether is it possible?

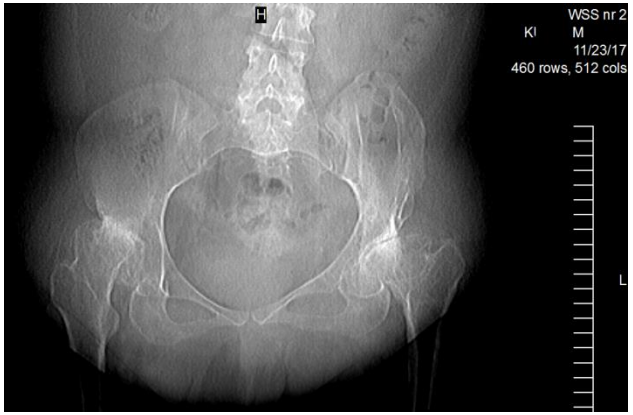
- Leg lenght inequality after THA:
  - important functional parameter, strongly associated with successful arthroplasty
  - the cause of abnormal gait with increased energy expenditure and excessive wear of rolling surfaces
  - leads to revision operations
  - reason for legal disputes
- The acceptable difference is **<10 mm**.
- Despite the careful operation, an unexpected greater difference may occur
- The reason may be a lack of pre-operative planning.

- Pre-operative planning:
  - allows to plan the course of the operation
  - predict its consequences for the patient
  - prepare implants
  - increases the safety of the patient and surgeon.



- Before planning arthroplasty:
- interview
    - was the hip joint previously operated
    - what cause the disease
  - clinical examination
    - location of postoperative scars
    - **tissue contractures**
    - **compensatory spine and pelvic dynamics**
    - preoperative leg length inequality
  - RTG
    - the possibility of performing the operation
    - how to embed implants
  - CT 3D in difficult cases.

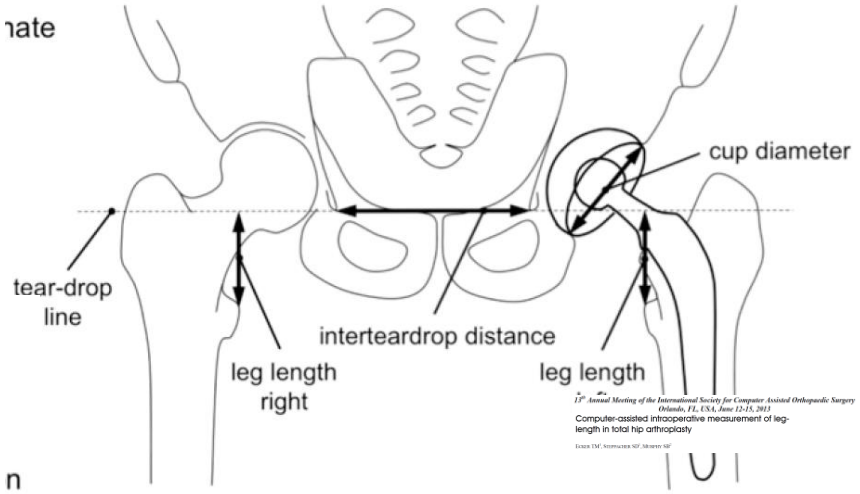
- Fixed spinal deformity or long spinal fusion and/ or limited dynamic change of lumbosacral spine:
  - Relative long length inequality (despite anatomical long length equality) due to pelvic obliquity
  - Limited range of the hip joint movement and/ or impingement cause further dislocation.

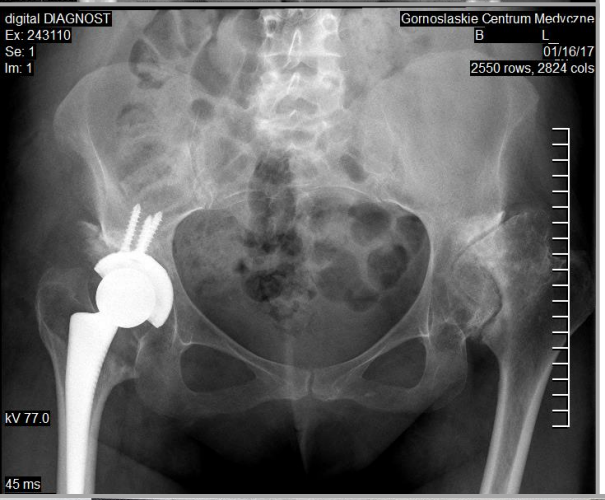


	Balanced	Unbalanced
Flexible	Cup anteversion from 5 to 25 degrees (normal safe zone)	Spinal realignment followed by THA •Cup anteversion from 15 to 25 degrees **OR** Primary THA •Kyphotic – decrease cup anteversion •Lordotic – increase cup anteversion
Rigid	Cup anteversion from 15 to 25 degrees	Spinal realignment followed by THA •Cup anteversion from 15 to 25 degrees **OR** Primary THA •Kyphotic – decrease cup anteversion •Lordotic – increase cup anteversion

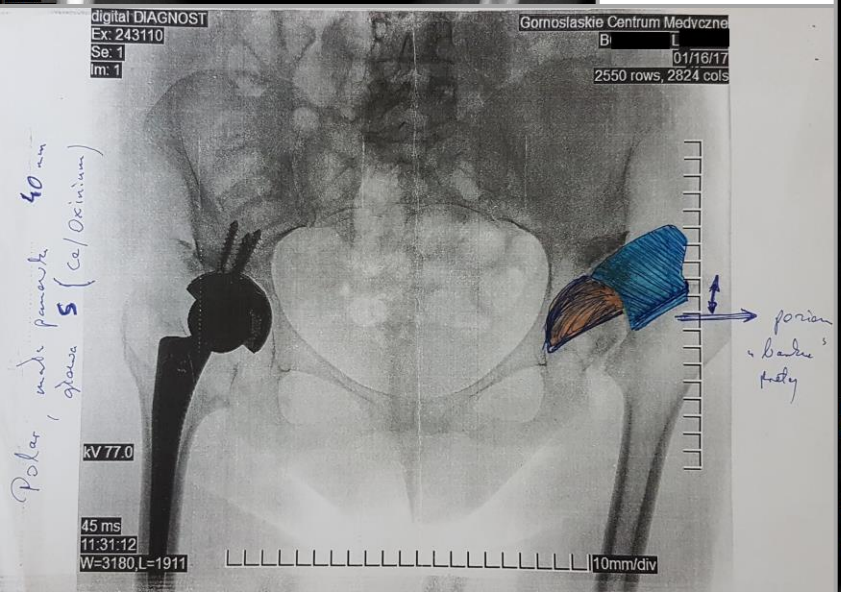
- Preoperative planning. How to do it?

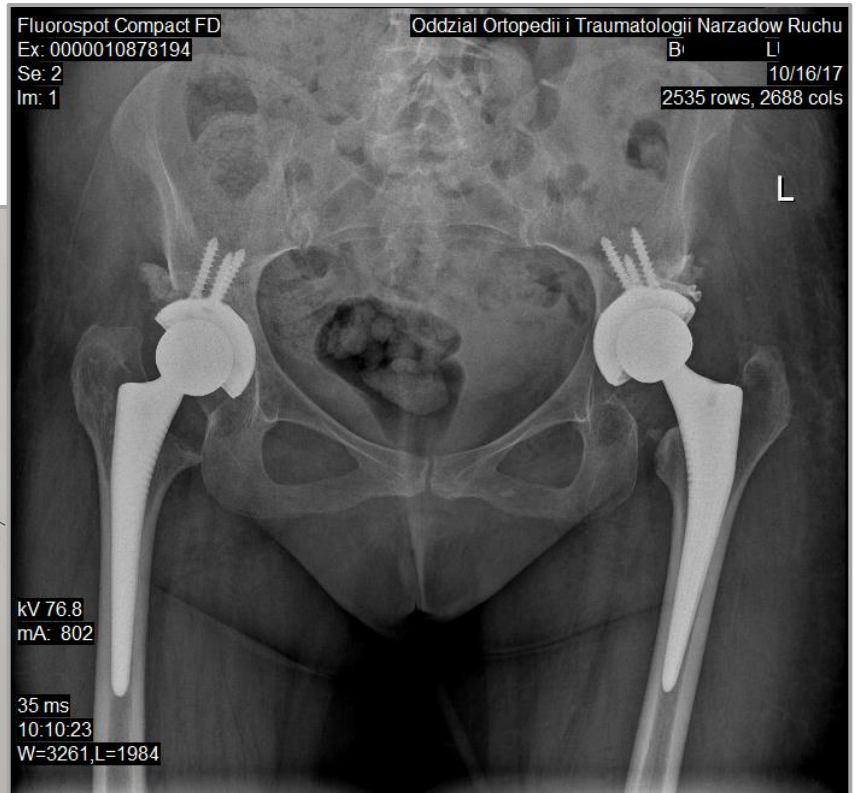
- Visualization:
  - Positioning prosthesis components
  - Restore the hip biomoechanics to normal conditions
  - Avoid LLI.





- Planning the placement of implants:
  - Drawing on RTG print
  - 2D template on RTG film.
- Low accurency of conventional 2D templeting for THA.





- Templates to plan the placement of implants :

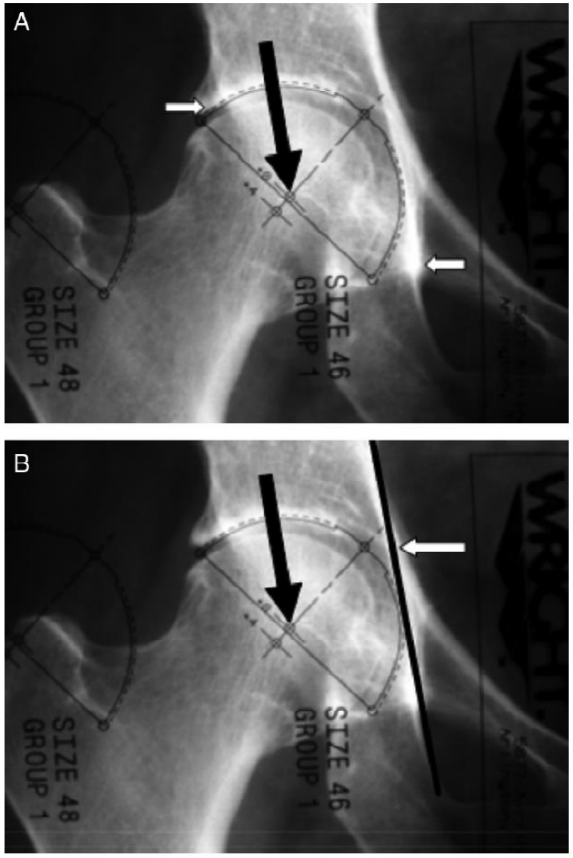


Fig. 1 – (A) Overlaying the transparency of the acetabular component on the normal side. The white arrow on the left side indicates the upper lateral border of the acetabulum. The white arrow on the right side indicates the teardrop. The center of rotation (CR) of the hip is marked on the transparency and is indicated by the black arrow. (B)

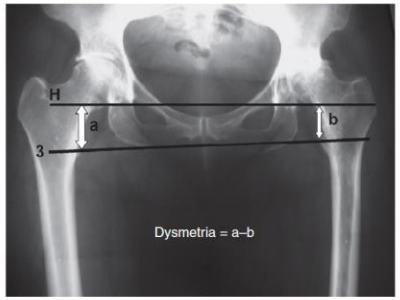


Fig. 6 – Calculation of the dysmetria. The dysmetria is obtained as the difference in the distances between line H and line 3 at the level of the lesser trochanters. The difference in measurements between segments "a" and "b"

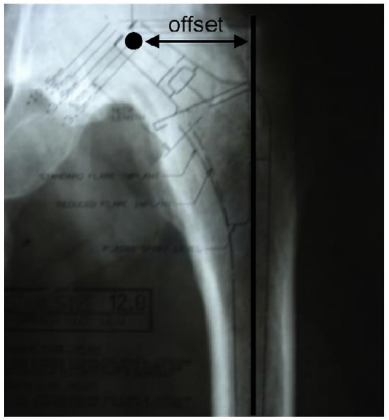


Fig. 3 – Offset of the prosthesis.

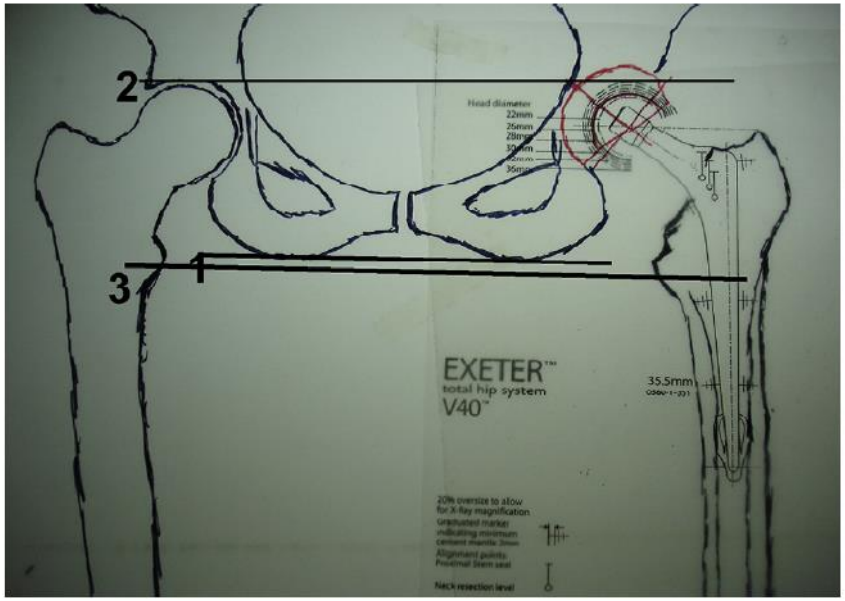


Fig. 8 – Preoperative planning. Lines 1, 2 and 3 are parallel.

Rev Bras Ortop. 2014;49(2):140-148

- Both templated (estimated) stem and cup size were significently different than implanted after 2D planning.

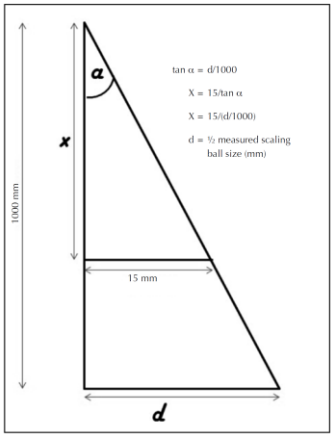
Accuracy of template sizes for acetabular cup and stem components

Template size	No. (%) of patients	
	Acetabular cup*	Stem
Correct	28 (53)	26 (49)
1 size error	18 (34)	23 (43)
2 size errors	6 (11)	3 (6)
3 size errors	1 (2)	1 (2)

* One size difference equals 2 mm

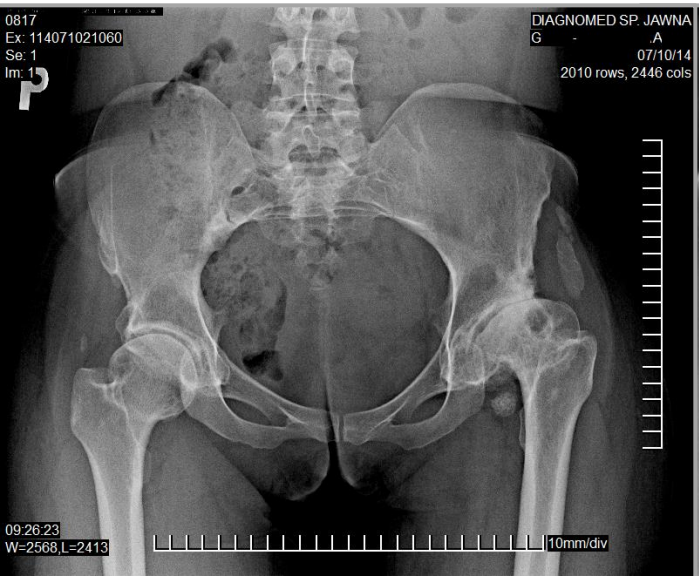
Magnification factors in pre- and post-operative radiographs

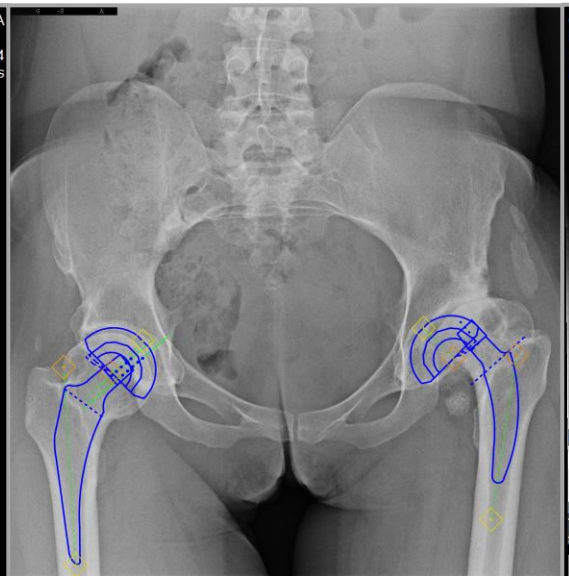
Patient	Mean (range) magnification factor (%)		p Value
	Preop	Postop	
All	122 (116–128)	127 (120–132)	<0.001
Male	122 (117–127)	126 (120–130)	<0.001
Female	123 (116–128)	128 (123–132)	<0.001

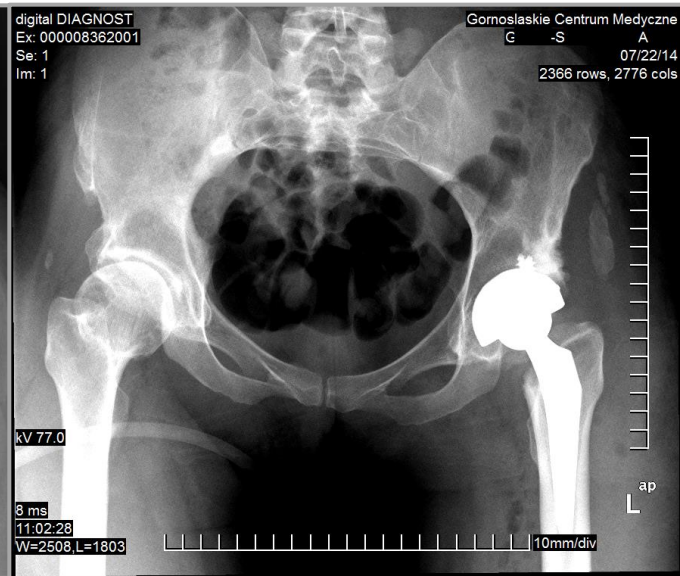


Journal of Orthopaedic Surgery 2014;22(2):173-6
Accuracy of preoperative templating in total hip arthroplasty
Andrew Riddick,[1] Adam Smith,[2] D Phill Thomas[3]

- The more predicted result is obtained using computer programs using the DICOM or JPEG files
- They allow to determine the size of implants
- 2D templating is probably related to the fact that the hip anatomy is not accurately analyzed on radiographs, especially changes in **the spatial structure of the joint caused by the disease and previous operations.**







- Planning on a 2D image of the hip joint:
  - Does not include femoral anteversion
  - Cause mistakes:
    - Size of the cup in atrthroplasty of dysplastic hip (difference in superior- inferior and anterior- posterior diameter of acetablum), no anterior acetabular edge
    - Unnoticeble changes of femoral intracanalar volume (usualy smaller size in Medio- Lateral than Anterio-Posterior).

- Advantage of 3D computerised preoperative plammimg:
  - The accurency between the planned positioning and the positioning of the implants
  - Anticipation of the surgical difficulties ex. bone abnoramalities after previous operation.
- Allows comparison with a nonarthrotic hip.

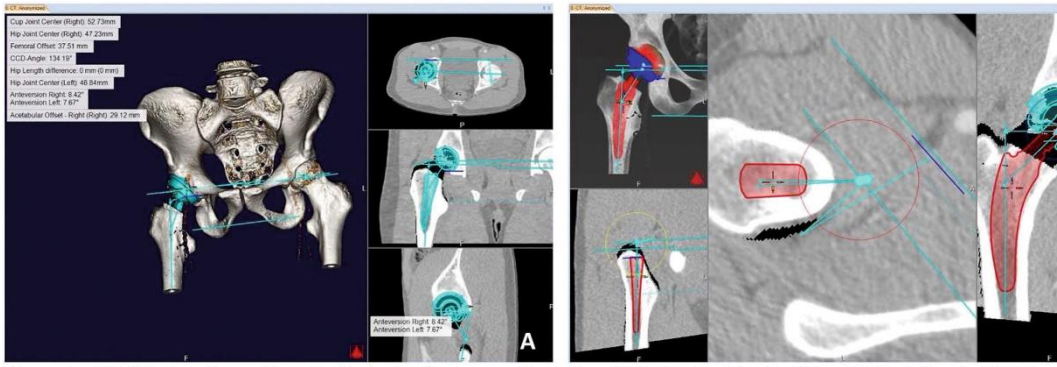
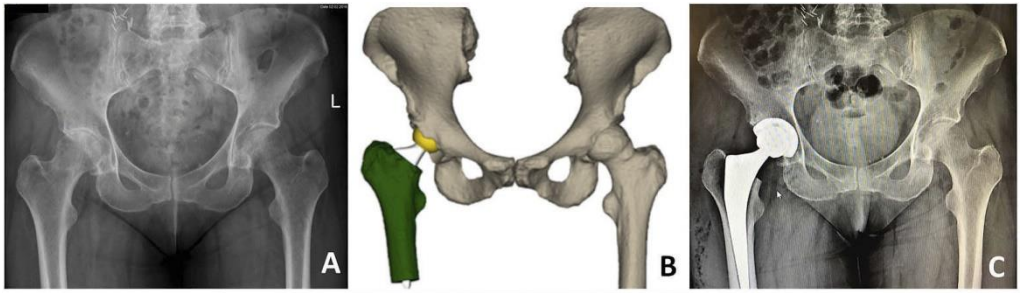


Figure 1 – 3D-CT planning with a dedicated software package (mediCAD©, HecTec GmbH). A) Most if not all THA planning software have 3D reconstruction functionality and allows positioning of the acetabular component on th coronal and sagittal 2D views. B) This is also possible with stem anteversion and position of the femoral head.



	Post-op Report			
	Radiographic measurements		Offset and leg length	
	Inclination	**Version**	**HFO**	**VFO**
Planned	40°	20°	40mm	53mm
Achieved	38°	20°	35mm	54mm
Difference	**-2°**	**0°**	**-5mm**	**+1mm**

Orthopaedic issue 181
3D-CT: A better map for hip surgery

- CT 3D allows to:
  - Determination of femur neck osteotomy relative to anatomical structurs (accurently predicted cranio-caudal blockage level of the stem prevents LLI)
  - visualization of the position of the stem in the medullary canal (prevention of THA dislocation).

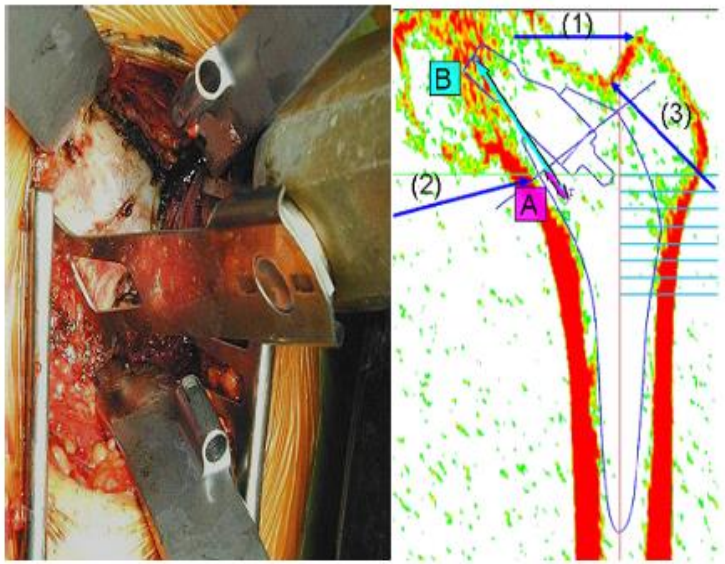


Figure 3 The distances from the neck-osteotomy plane to the top of the greater trochanter (1), to the top of the lesser trochanter (2) and to the digital fossea (3) were measured in order to check the seating level of the stem during the surgery.

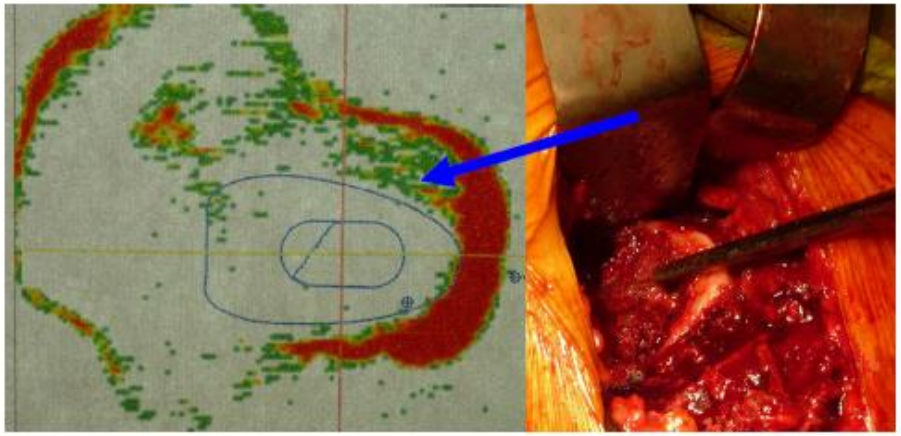


Figure 4 A view of the neck-osteotomy plane was given to the surgeon in order to visually control the position of the stem during the rasping procedure and to determine the supportive cancellous (blue arrow) to keep in order to achieve good rotational stem stability and to check the final femoral anteversion.

- Planning with the use of CT 3D allows the use of robotic arm-assistance achieved greater accurency in preparation and position of the acetabular cup during THA

2017 vol. 2
Mako Partial Knee, Total Hip and Total Knee

- Planning robotic- arm assisted operation:
  - bone cut and reaming without trials
  - accurate and reproducible in component placement to plan
  - bone preservation due to less amount of bones stock reamed during primary THA (smaller cup size)
  - minimizing surgical complications
  - Accurate in cup inclination, cup anteversion, reproducing center of rotation- the risk of hip dislocation.

Table 1 - The average inclination and anteversion values of the acetabular components in the study, showing the pre-operative plan, measures recorded interoperatively and those measured from plan radiographs using the Martell method.[2]

	Pre-op plan	Intra-op robotic-arm measurements	Martell radiographic measurement
Inclination	40.0° ± 1.2°	39.9° ± 2.0°	40.0° ± 4.1°
Version	18.7° ± 3.1°	18.6° ± 3.9°	21.5° ± 6.1°
Count (n)	119	119	110

- Based on Mako data (3-D
Callanan safe zone (30°-

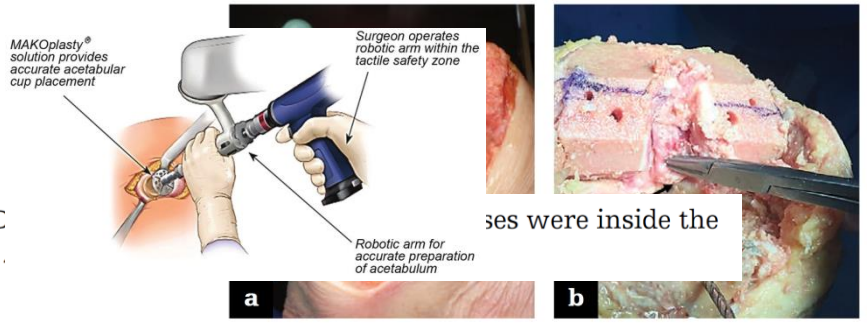


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Figure 5. a) A robotic-arm assisted TKA with bone island preparation in front of PCL. b) Manually performed TKA with arrow pointing to PCL with no bone island preparation. Black arrow points to (a) intact PCL in the RATKA and (b) minor fray of PCL in the MTKA. White arrow outlines bone island. Blue arrow points to intact patellar ligament.[19]

Concusions part I

- Planning is necessary in all so-called difficult cases.
- It is not necessary at the so-called standard arthroplasty after careful X-ray analysis.
- Computer-assisted planning allows to plan the size of implants, reduces the risk of leg lenght inequality.
- A potentional benefit of robotic- arm assisted THA.

Conculsions part II

- Planning, however, has no expected positive impact on:
  - clinical outcomes
  - patient's subjective leg lenght inequality.
- Available pre-operative planning systems are not able to take into account the effects of postoperative scars and tissue contractures on:
  - postoperative LLI (leg lenght inequality)
  - postoperative ROM (range of motion).


Thank you!