

# Principles of acetabular fixation in primary and revision hip arthroplasty

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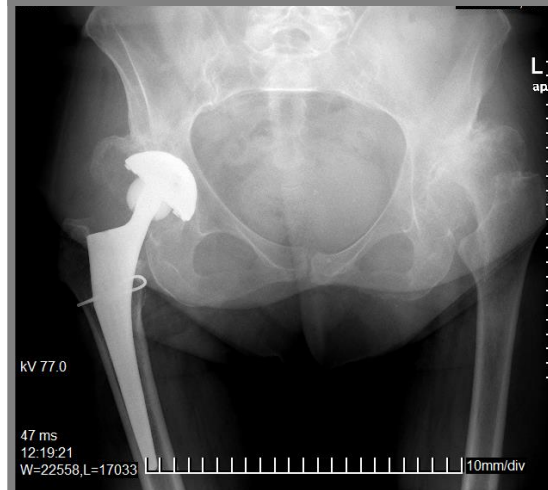


- Do we see the difference ?
- Which type of acetabular cup should be the gold standard ?



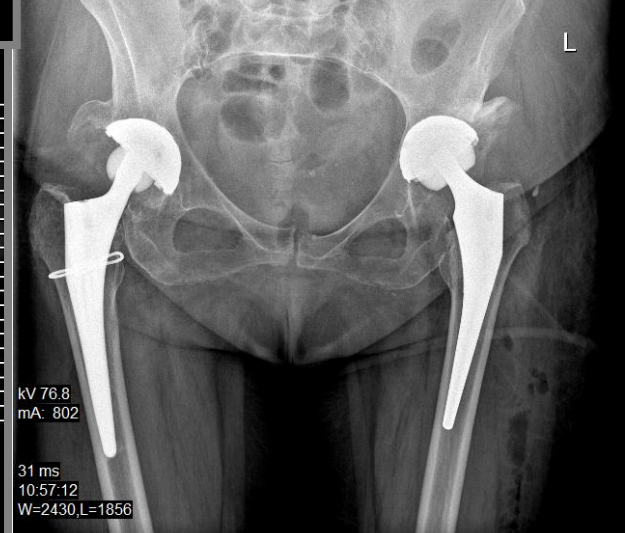
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Se: 1  
Im: 1

Gomoslaskie Centrum Medyczne  
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10/27/14  
2652 rows, 3001 cols

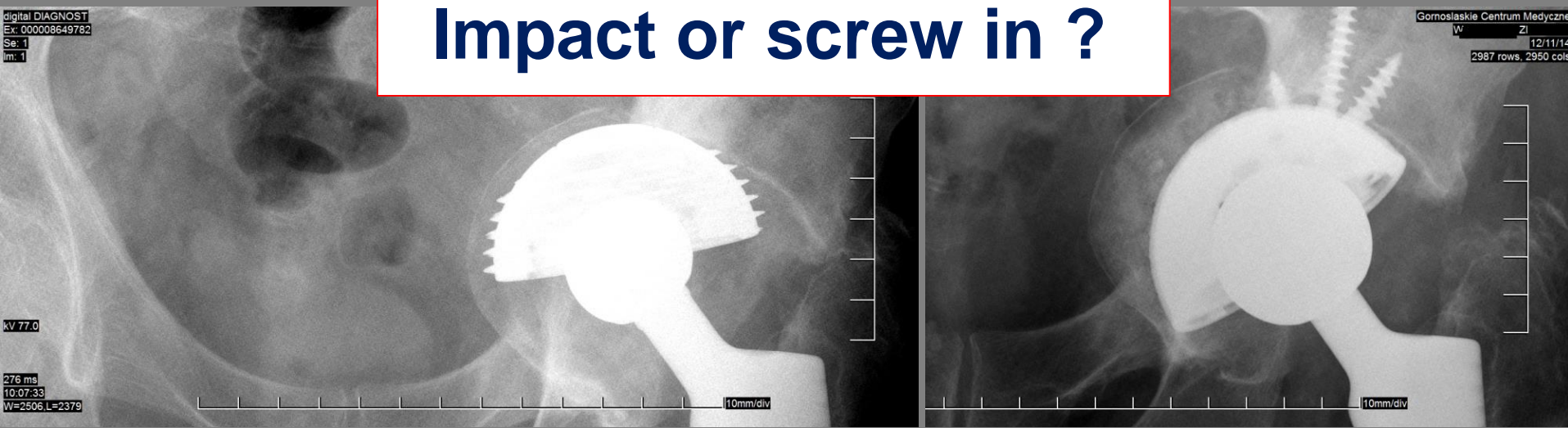


Fluorospot Compact FD  
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m: 1

Oddział Ortopedii i Traumatologii Narządów Ruchu  
SUCHODOLSKA BOGUSŁAWA  
11/04/15  
2664 rows, 2586 cols



# Impact or screw in ?

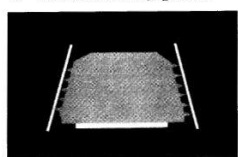


- The survival of acetabular cup depends on the stability in surrounding bone stock

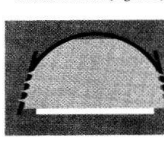
[Lazarinis S i wsp: Increased risk of revision of acetabular cups coated with hydroxyapatite. Acta Orthopaedica 2010; 81\(1\): 53–59](#)

- Aseptic loosening of the acetabular component shortens the functioning of hip prosthesis significantly.
- The most common reasons:
  - osteolysis of bone stock caused by macrophages (reaction "around the foreign body")
  - loss of bone stock due to overloading and micromotions of acetabular cup

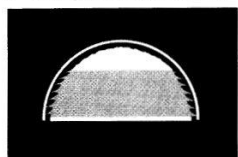
A. Truncated cone (Figure 2)



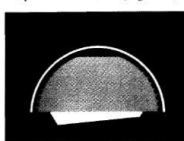
C. Hemispherical shell with conical threads (Figure 4)



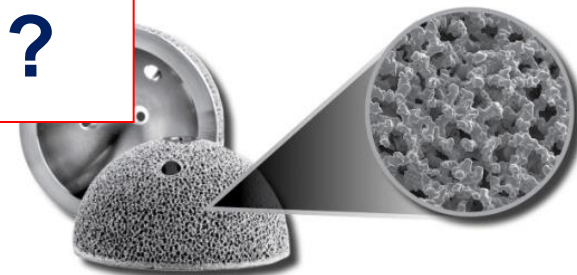
B. Hemispherical ring (Figure 3)



D. Hemispherical shell with spherical threads (Figure 5)



## Impact or screw in ?



- Stability of uncemented acetabular cup depends on:
  - initial mechanical stability: caused by proper shape (threaded cylindrical surfaces, conical, elliptical or semi-circular)
  - secondary stability after bone ingrowth at the bone–implant interface (hydroxyapatite-coated acetabular cups, porous, porous - coated with hydroxyapatite)
- Secondary stability prevents micro-movements between cup and the bone more than **40-50 um**

# Threaded cup

- Threaded cup was applied by Sivash in **1957** and gained popularity in Europe and later the US
- Cup stability is obtained only by screwing into the bone like the screw – it makes impossible the long term survival
- It gives a very good initial stabilization (**> 2.5x than press fit**), but lack of secondary stability (**especially in case of incorrect implantation**) leads to loosening because of multidirectional loads
- The disappointing long-term outcomes led to the development others designs of shape (**truncated conical-screw socket developed by Zweymuller had the longest survival**)

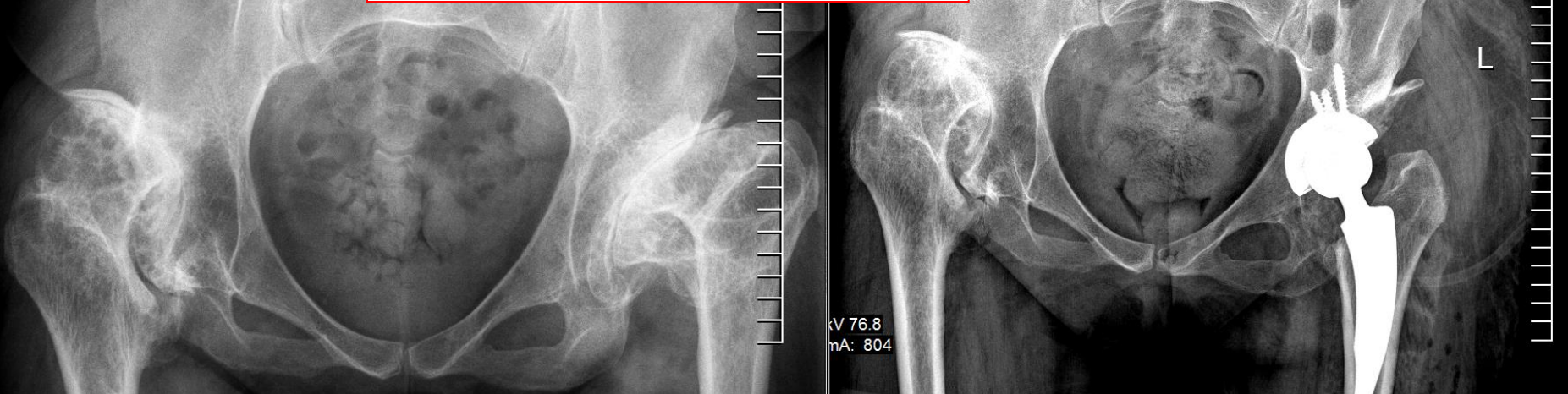
# Threaded cup

- Loosening of threaded cup :
  - it is difficult to make the threaded surface capable to bone ingrowth
  - there is a small contact area of the thread with the surrounding bone stock which causes a loss of bone and the formation of connective tissue because of overloads
- It causes high rates of aseptic loosening; **4% -31%**, with a mean follow- up **3,5-10 years** (Fox i wsp. JBJS 1994), and after **10 years 17 %** require revision procedure (Malchau i wsp. JBJS 2002)

# Threaded cup

- Threaded cup is used mainly in:
  - Osteoporosis
  - Osteoarthritis secondary to dysplasia
- They should not be used in revision arthroplasty:
  - difficult of obtained the initial stability in acetabulum with bone defects
  - lack of secondary stability

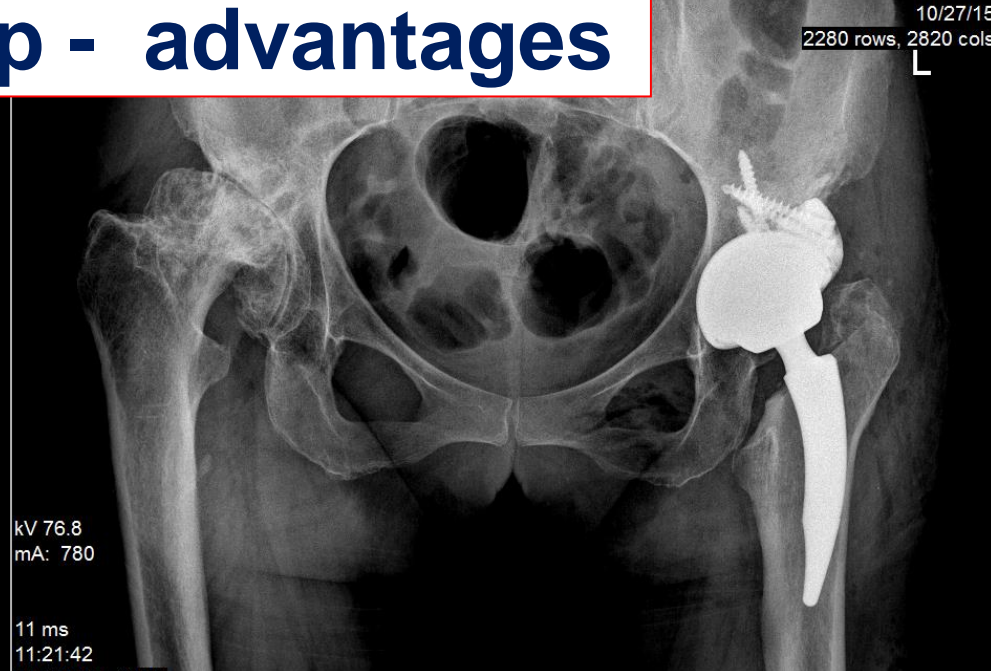
# Press-fit cup



- Hemispherical press - fit uncemented cup was introduced for use in the **80'**
- It provides a longer survival time, which results of fixing into the bone:
  - it transmits the loads in physiological way to the surrounding bone tissue
  - secondary stability is achieved by the bone ingrowth



# Press-fit cup - advantages

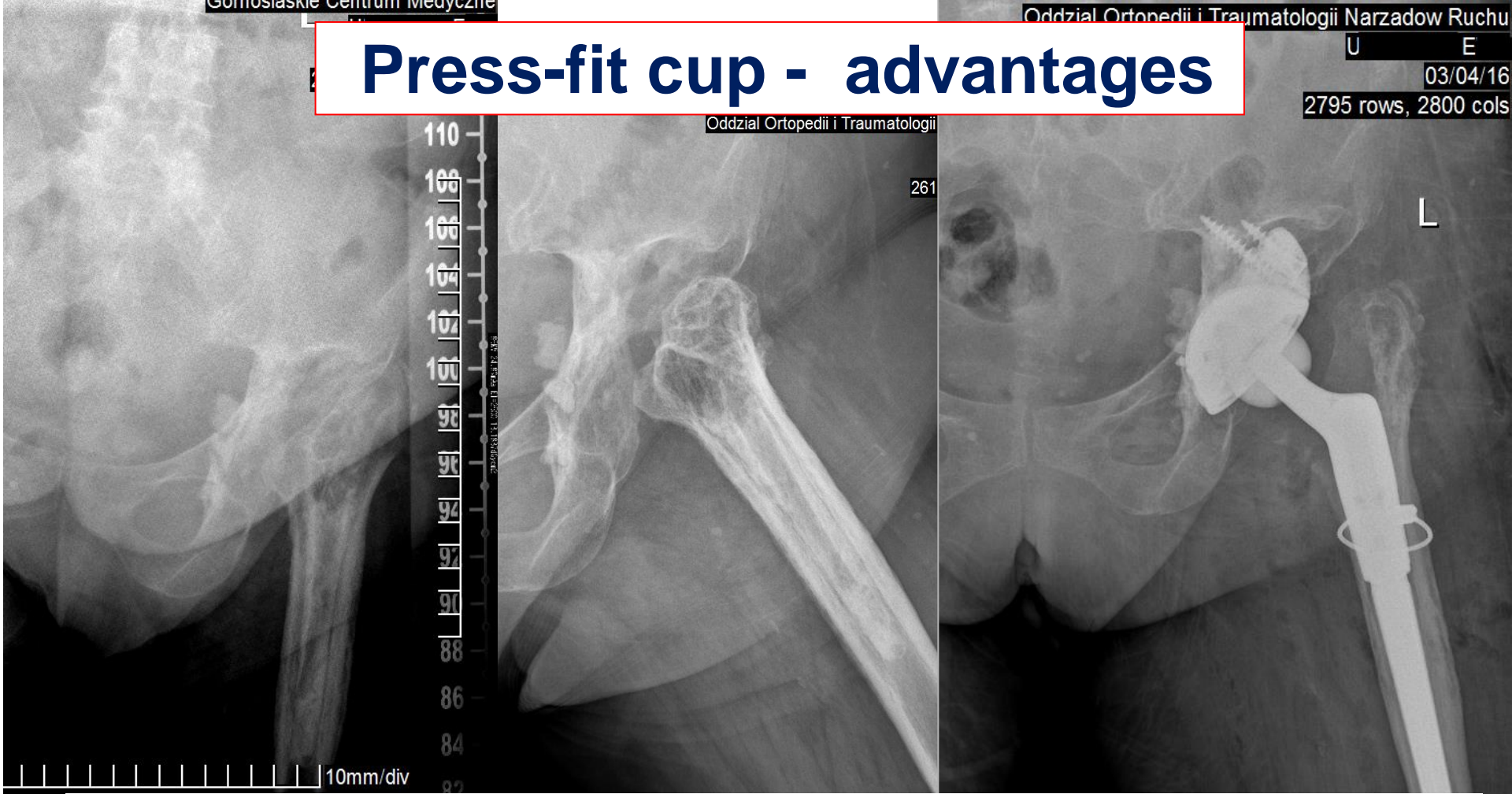


- Cup is universal
- You can use it in any type of acetabulum while the primary or revision arthroplasty
- There is no difference in survivorship with an additional screw stabilization - **100% / 98.4% after 15 years** (spikes shorten cup survival time)

Sheng-Hui Ni i wsp. Press-fit cementless acetabular fixation with and without screws. *Int Orthop.* 2014; 38: 7-12

Fritsche A i wsp. Experimental investigations of the insertion and deformation behavior of press-fit and threaded acetabular cups for total hip replacement. *J Orthop Sci.* 2008; 13: 240-247

# Press-fit cup - advantages



- Cup in universal:
  - it is a modular structure, allowing to management the acetabular bone loss with implants

# Press-fit cup - advantages

- Cup is universal:
  - it easily recreates the center of rotation of the hip joint



# Press-fit cup limitations

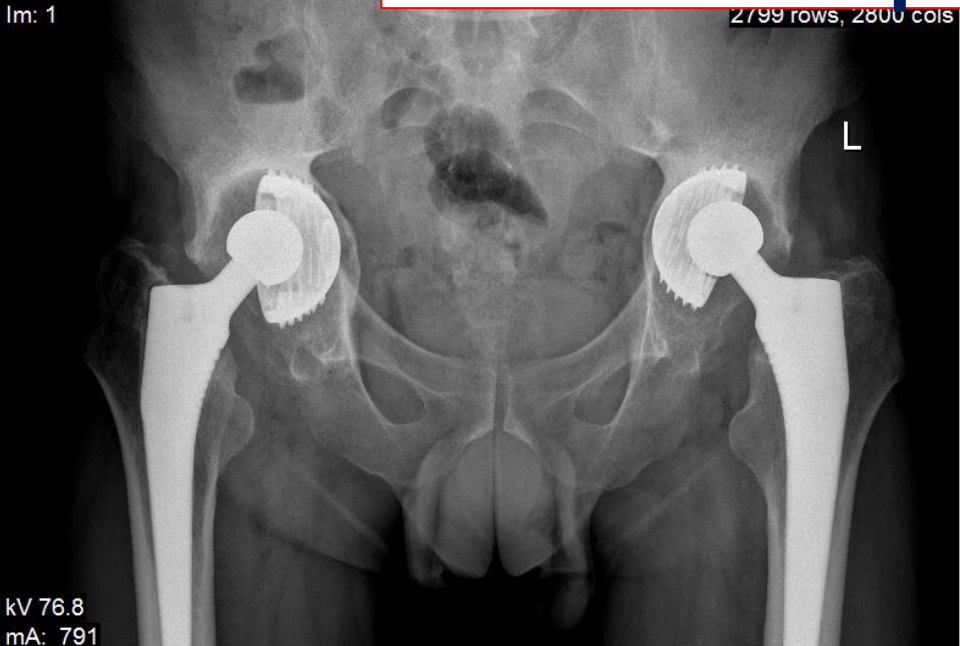
- In case of lack of initial stability, cup micro-movements make the secondary stability impossible
- In osteoporotic bone is difficult to obtain the initial stability without additional screws
- While impacting the walls bend, the deformation should not exceed **75 um** in order not to change the shape of polyethylene or metal insert (causing them to excessive wear, especially when using "large" heads or rupture the ceramic insert)

Goebel P i wsp. The influence of haediameter and wall thickness on deformations of metallic acetabular press-fit cups and UHMWPE liners. J Orthop Sci. 2013; 18: 254-270

- Aseptic loosening is more often when the lateral inclination angle is more than 50 degrees
- They loosen quickly (after 5 years) when the outer surface is smooth and covered only with hydroxyapatite

Kin-Wing i wsp. Early Failure of Smooth Hydroxyapatite-Coated Press-Fit Acetabular Cup-7 Years of Follow-up. The J Arthroplasty. 2006; 20(5): 627-631

# Press-fit cup limitations

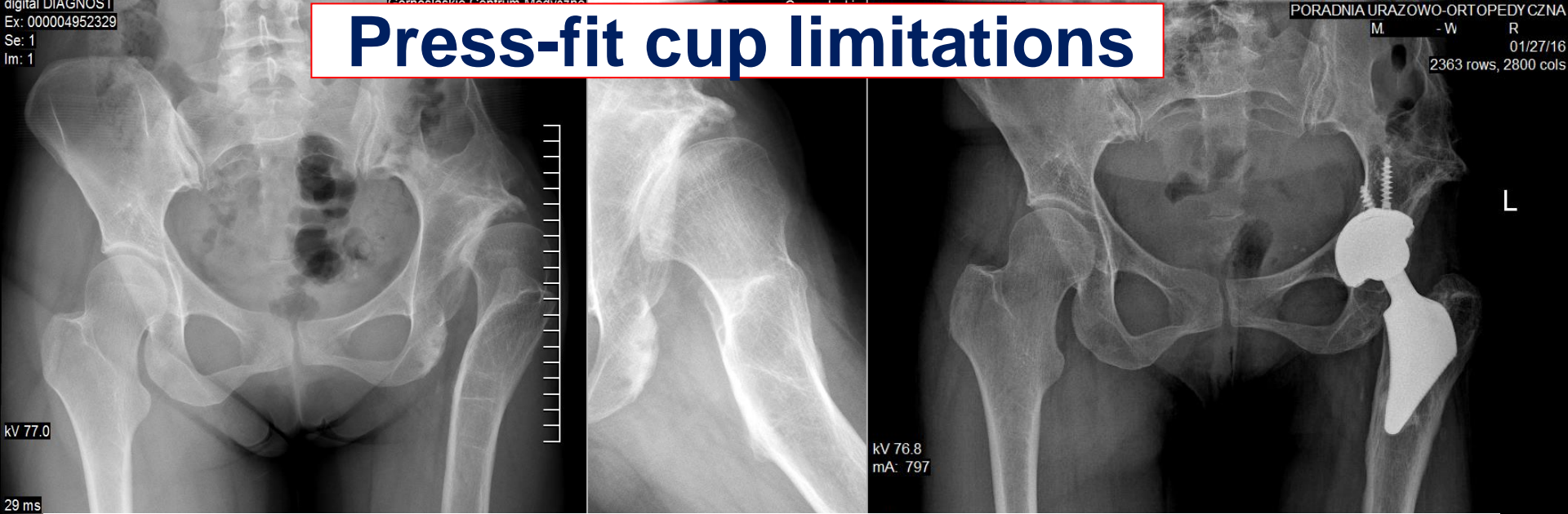


kV 76.8  
mA: 791

13 ms  
10:28:4  
W=297

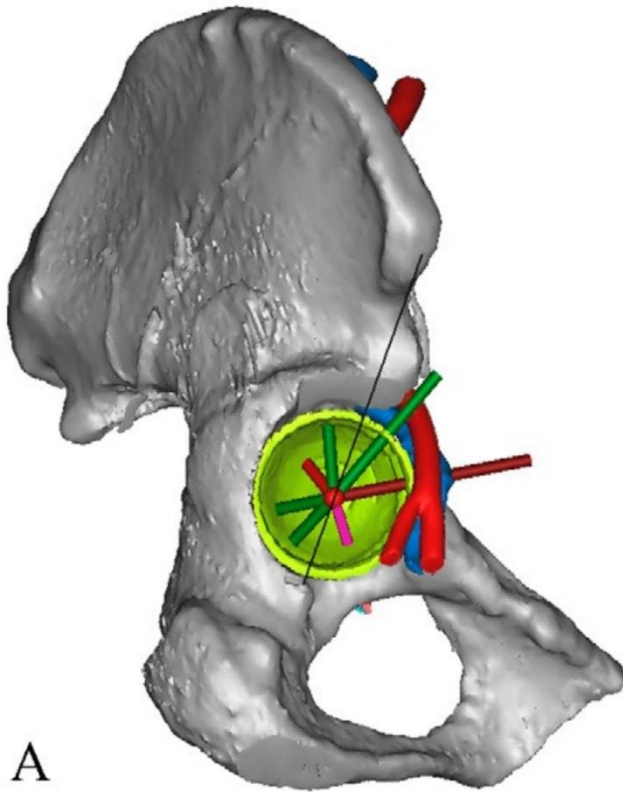
- Fundamental for stable cup implantation is placing in preserved bony ring of acetabulum
- The contact surface of the implant to the bone acetabulum:
  - **> 70%** bone graft is not needed,
  - **50-70%** support for the roof and the rear column of a bone graft (screws as an option)
  - **<50%** is not enough to support (cage or screws)

# Press-fit cup limitations

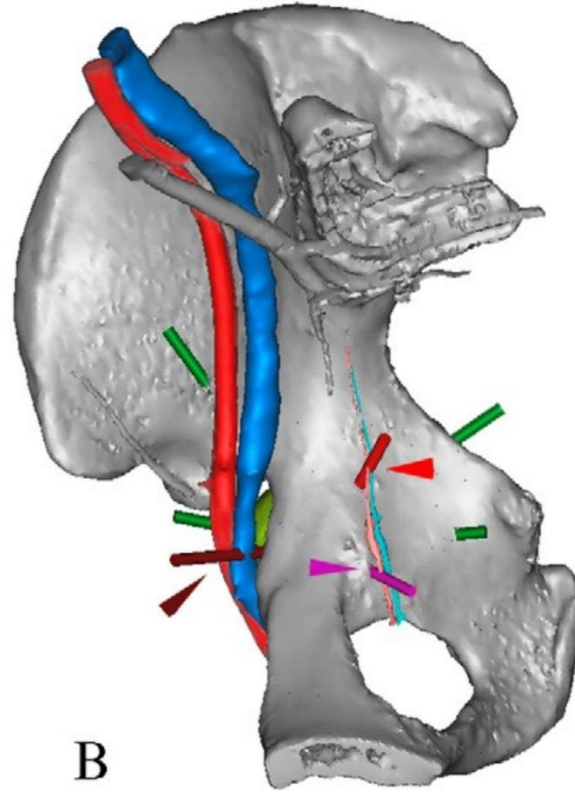


- More often we use screws for cup stabilization:
  - when the center of rotation of the hip joint is **> 3 mm** above the anatomical center of the acetabulum
  - in patients with osteoporosis
  - in women
  - in less active patients

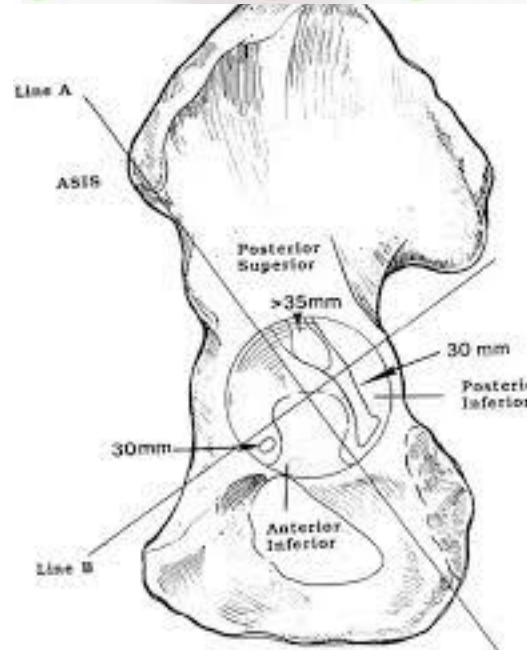
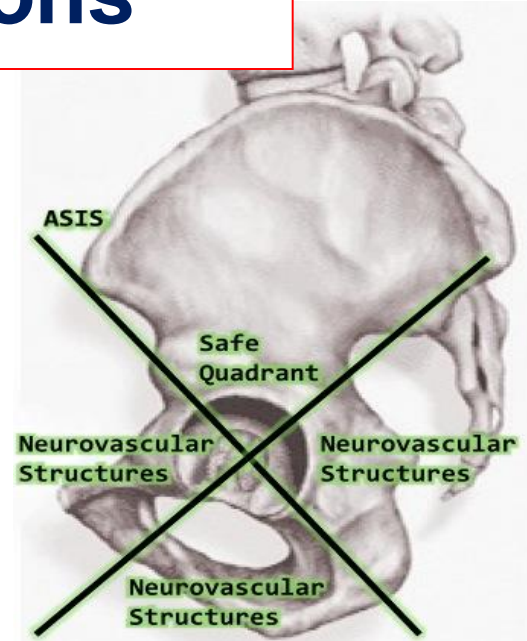
# Press-fit cup limitations



A



B



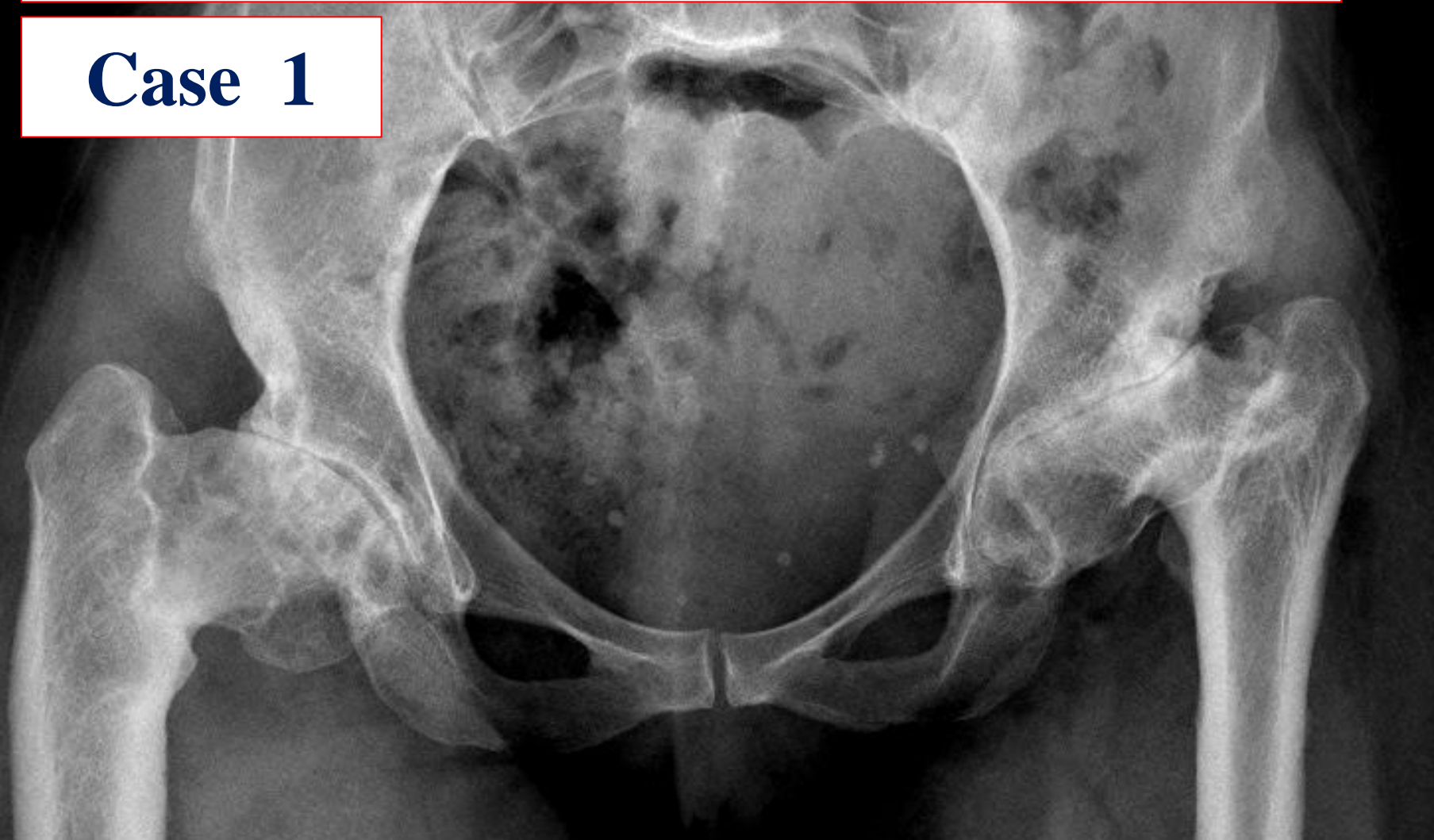
- The risk of damage the neuro-vascular structures because of additional stabilization with screws

Liu Q i wsp. Safe zones for transacetabular screw fixation in Prosthetic Acetabular Reconstruction of DDH. JBJS. 2009; 91 (Am): 2880-2885

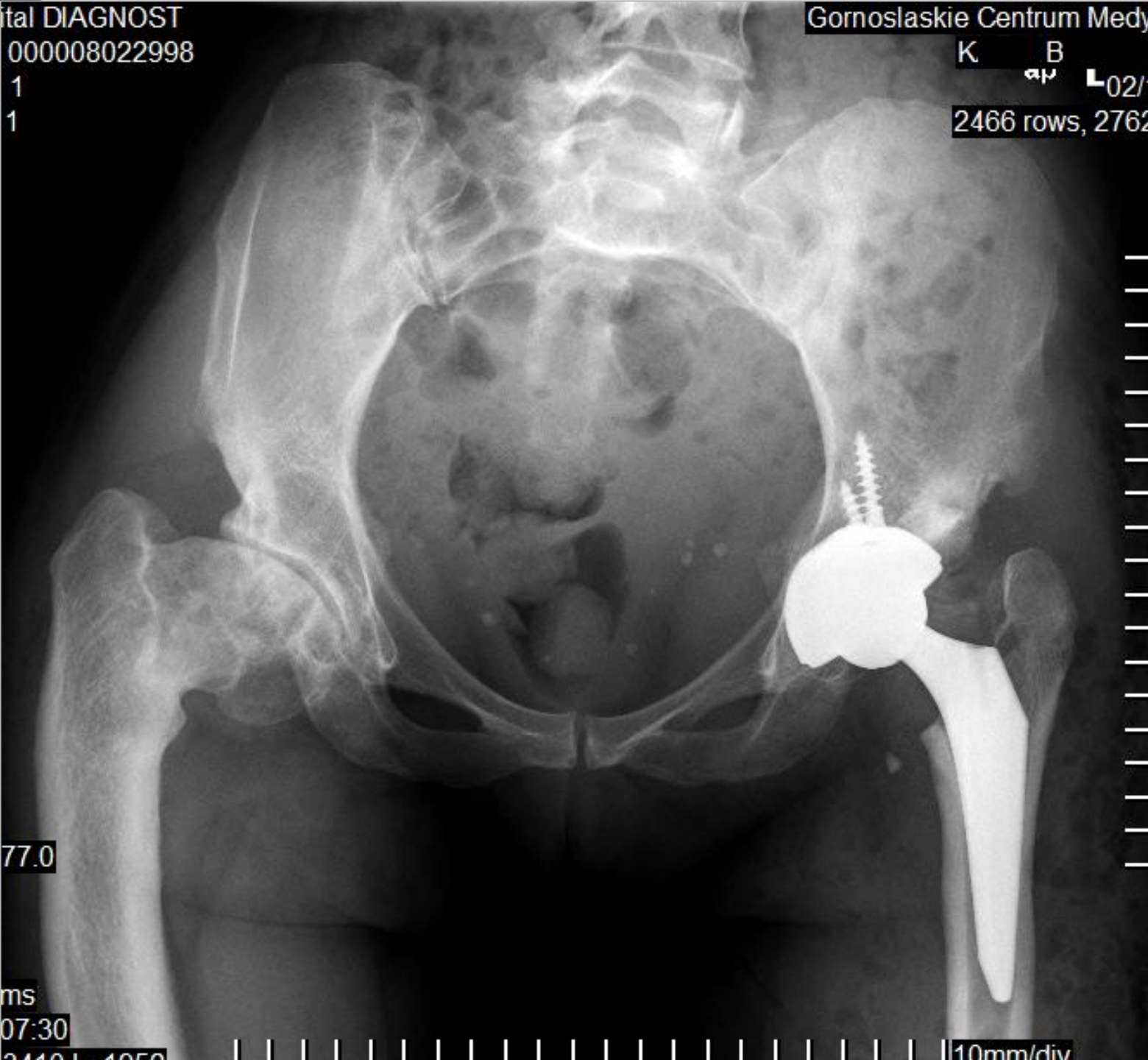
Barrack RL. Neurovascular injury: avoiding catastrophe. J Arthroplasty. 2004 Jun;19(4): 104-107

- Female **K. B.**, 43 years old, **BMI 23**, repeatedly treated surgically in childhood because of **DDH** hip **L** and **P**
- Primary endoprosthesis **02.07.2014**, without blood transfusion on religious grounds

## Case 1







Ex:  
Se:  
Im:

- Male **Ž.K.**, 45 years old, **BMI 31**, **ANV**
- Primary endoprosthesis

# Case 2



kV 76.8  
mA: 804

83 ms  
16:24:51  
W=3147,L=1856

09:44:42  
W=1022,L=476

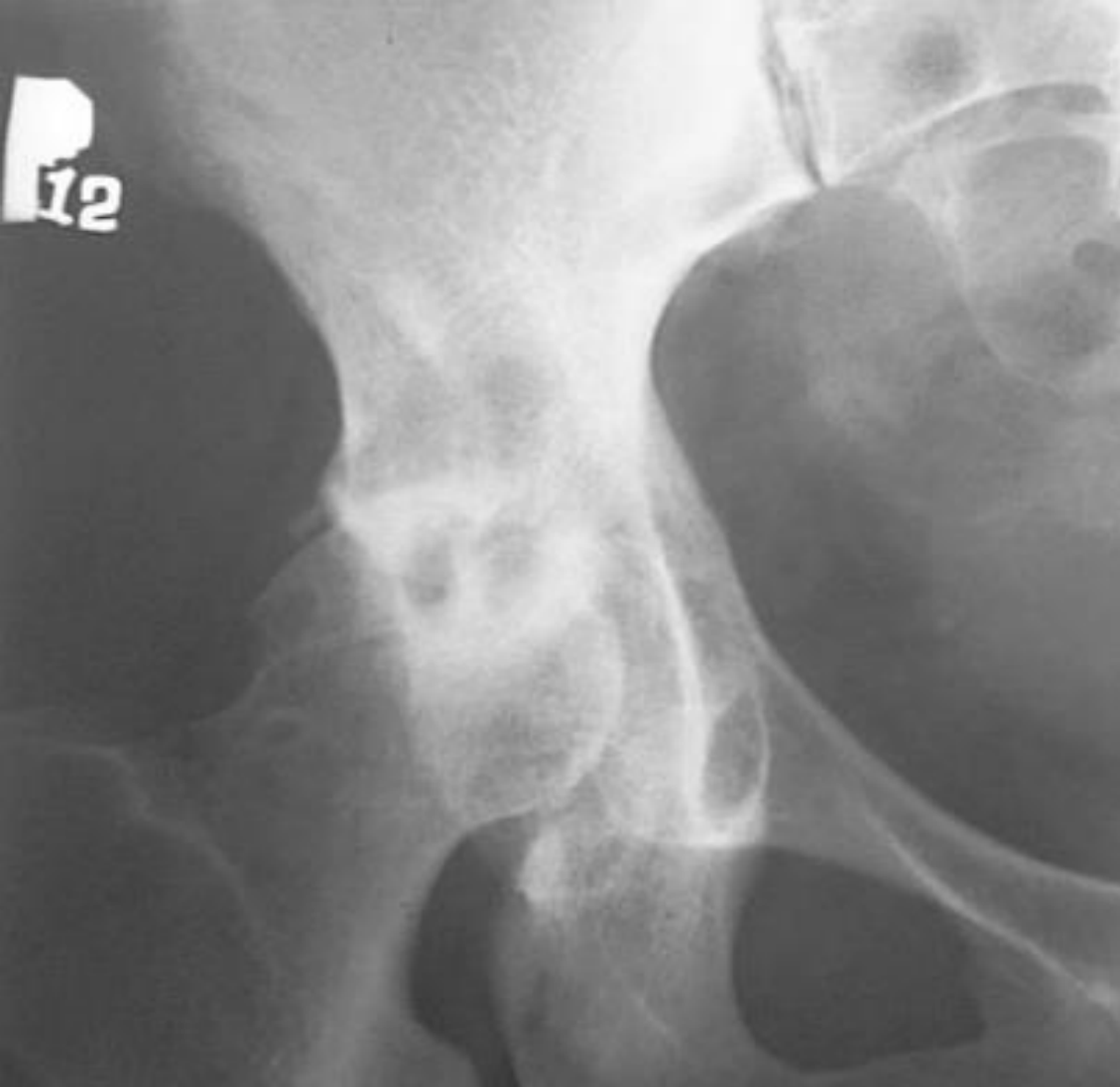




Fluorospot Compact FD Odd:  
Ex: 0000009570566  
Se: 2  
Im: 1

kV 76.8  
mA: 804

83 ms  
16:24:51  
W=3147,L=1856



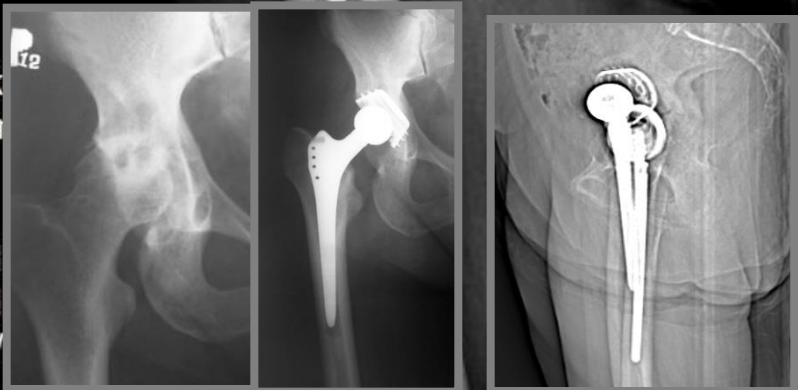
- Female **B.B.**, **82** years, **BMI 32**, **RA**, endoprosthesis **2007**
- Revision **06.10.2015**
- Aseptic loosening

**Case 3**

Fluorospot Compact FD  
Ex: 0000009260603  
Se: 2  
Im: 1

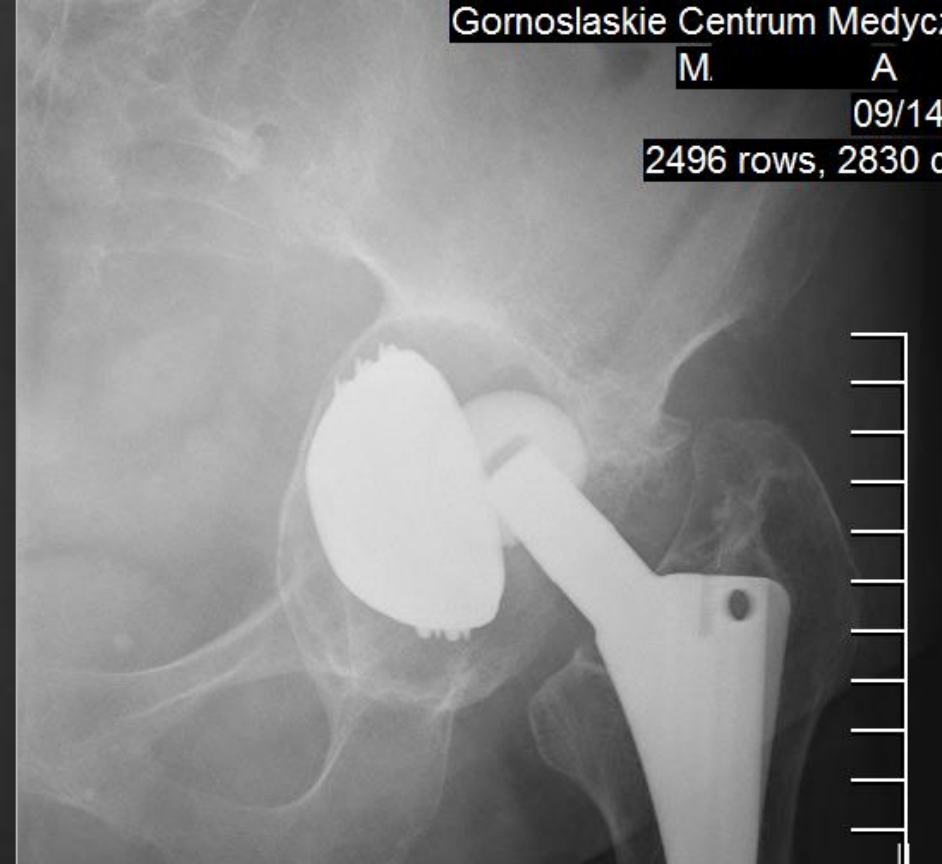


Fluorospot Compact FD  
Ex: 0000009279476  
Se: 1  
Im: 1



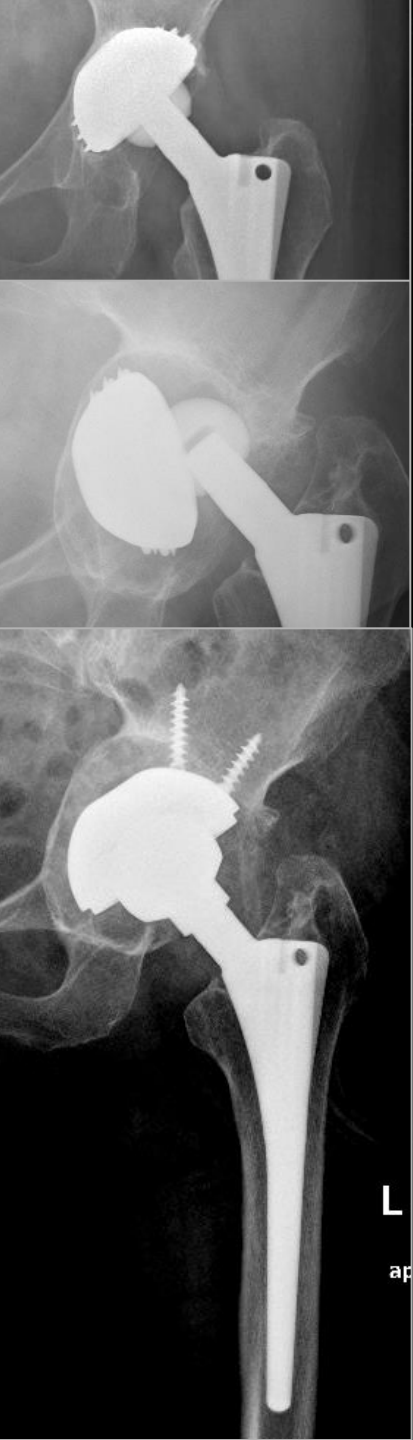
kV 76.8  
mA: 804

10 ms  
10:57:19  
W=2709,L=2175



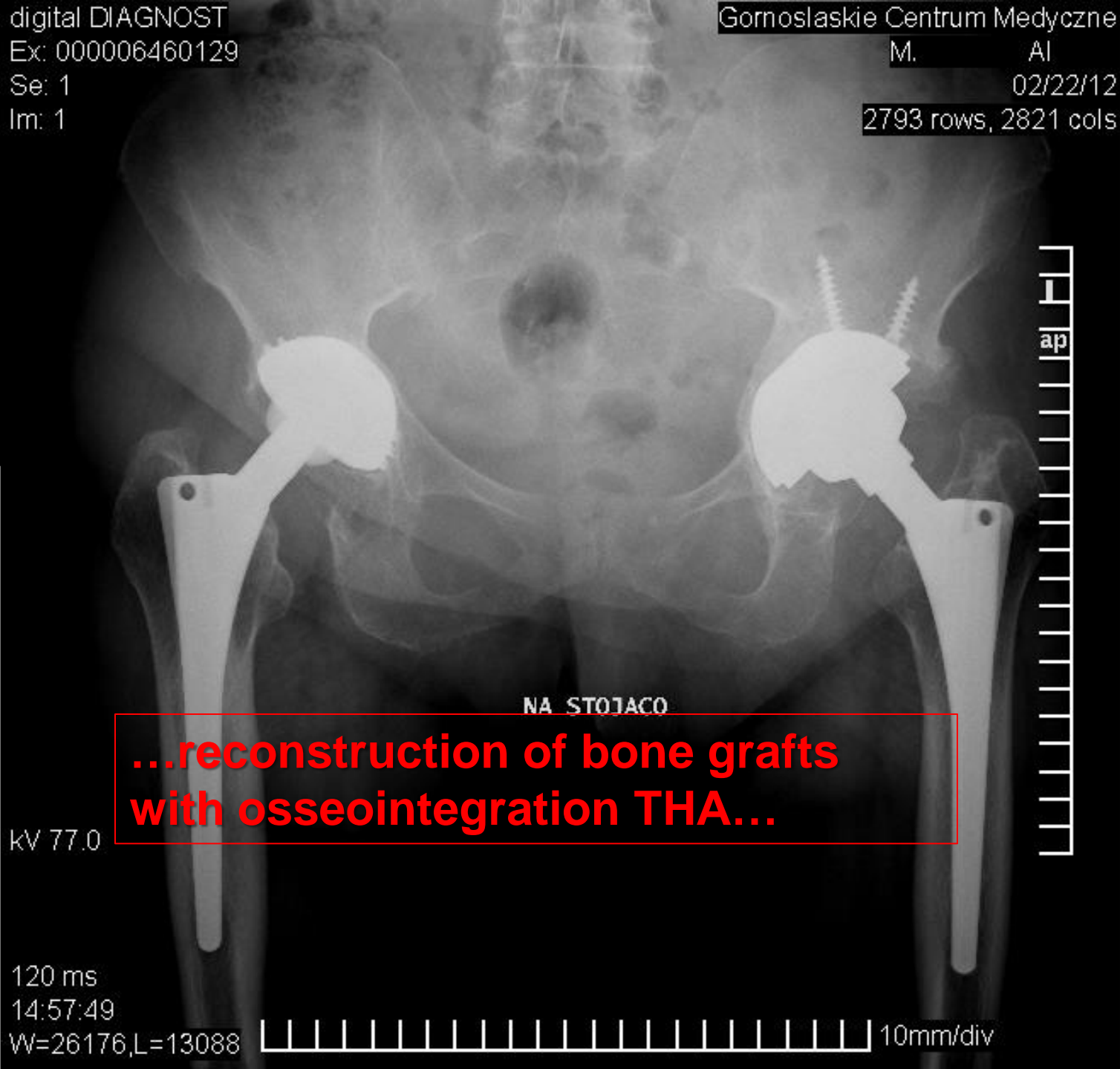
- Female **M. A.**, age **75**, **BMI 28**
- Primary endoprosthesis **LSB 2005**, **PSB 2006**
- Revision **LSB 21.09.2010**  
aseptic loosening

## Case 4



digital DIAGNOST  
Ex: 000006460129  
Se: 1  
Im: 1

Gornoslaskie Centrum Medyczne  
M. AI  
02/22/12  
2793 rows, 2821 cols



NA ST01ACO

**...reconstruction of bone grafts  
with osseointegration THA...**

kV 77.0

L  
ap

120 ms  
14:57:49

W=26176,L=13088

10mm/div



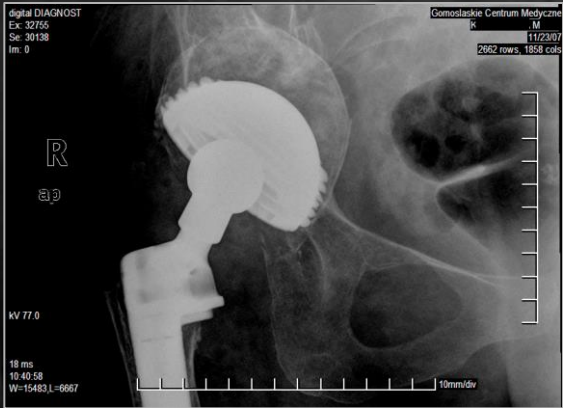
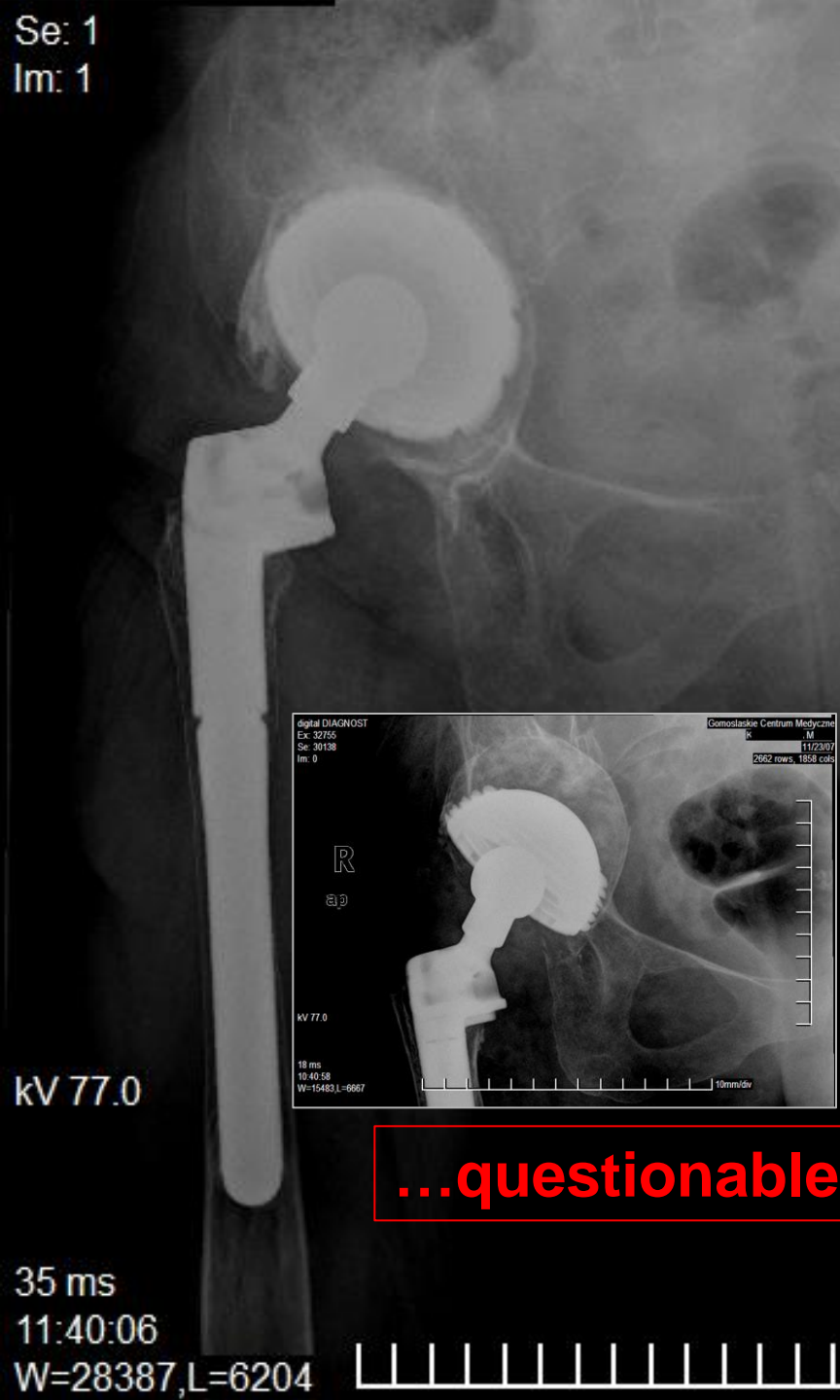
- Female **K.M.**, age **74**, BMI **34**, LSB **1990**, PSB **1998**
- Revision PSB: screwed acetabulum and stem **01.07.2008**,
- Antiprotrusio acetabuli **GAP II 26.05.2011**
- aseptic loosening, **RA**

**Case 5**





Se: 1  
Im: 1



kV 77.0

35 ms  
11:40:06  
W=28387,L=6204

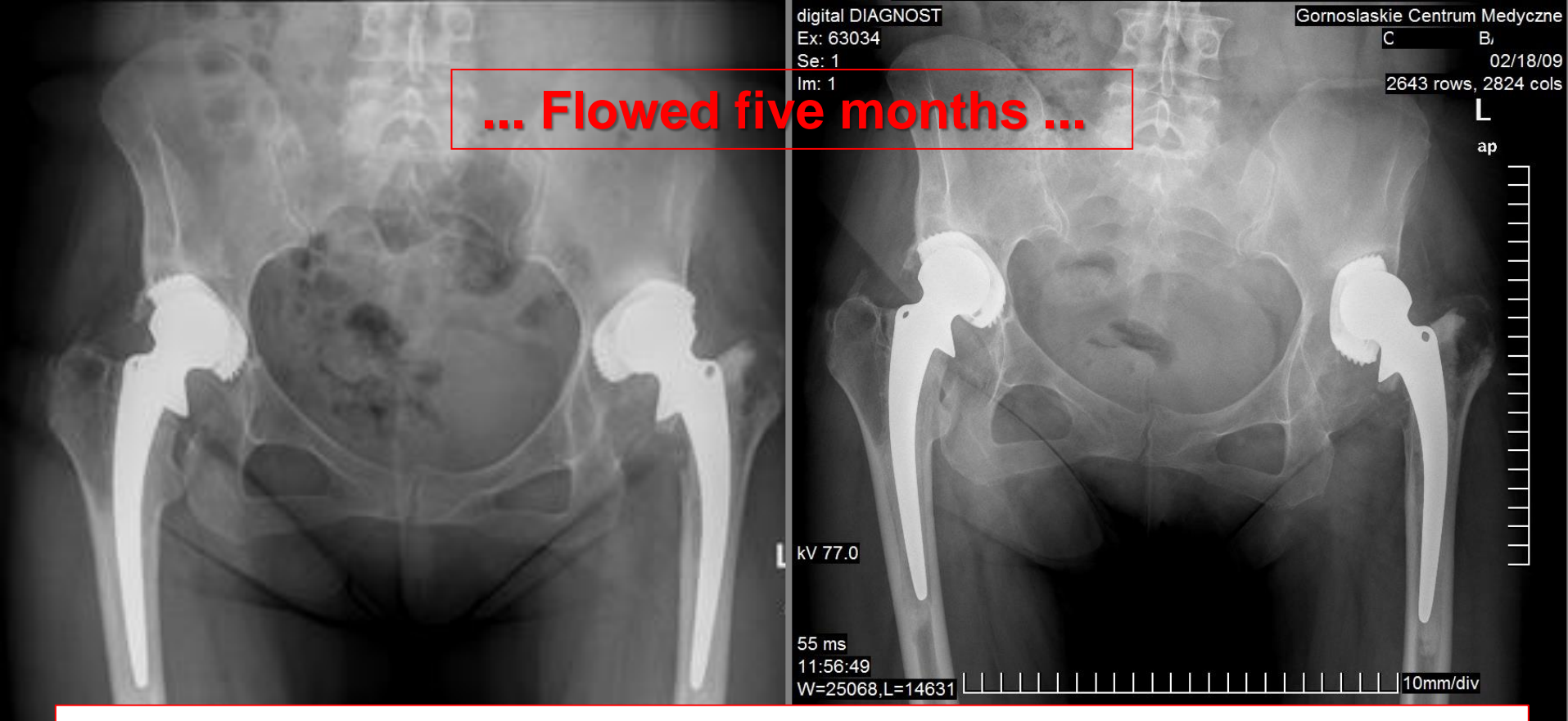


kV 85.0

43 ms  
12:23:46  
W=3126,L=2831

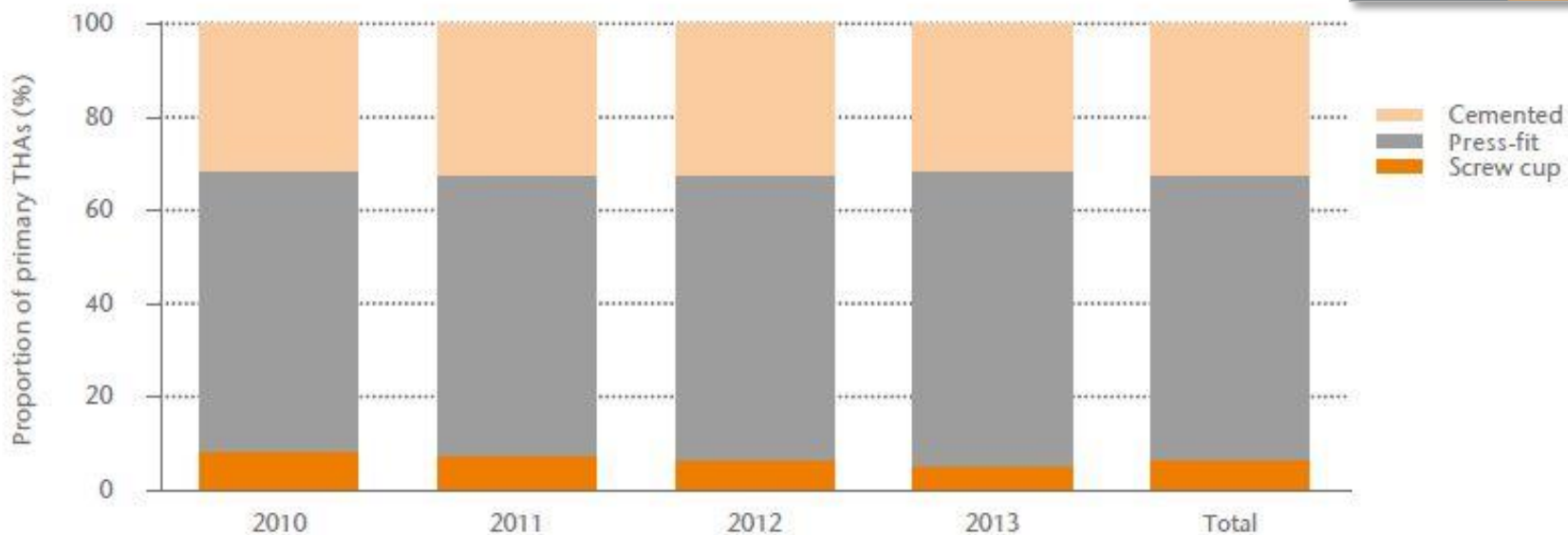


**...questionable effectiveness in RTHA...**



- **What is similar in those cases of patients with threaded cups?**
  - **the rate and extent of bone destruction**
  - **quite long time from primary surgery to revision? average of 7 years (5 - 10)**

# Registers



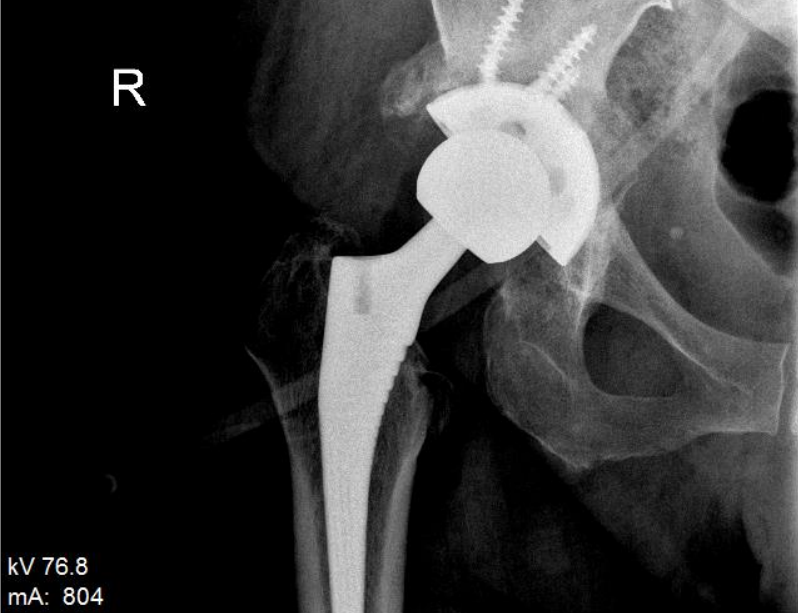
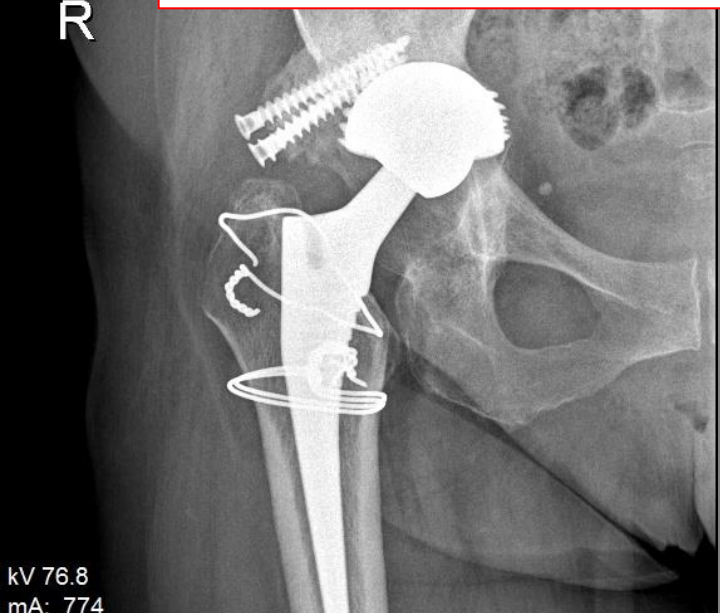
## Type of acetabulum

Cemented (%)	32.2	32.7	33.3	32.0	32.5
Press-fit (%)	59.8	60.3	60.5	62.9	60.9
Screw cup (%)	7.9	7.1	6.3	5.1	6.5
Total (n)	22,340	22,676	24,057	25,077	94,150

# Registers

	2005	2015
<b>Cemented cups</b>	<b>22,1%</b>	<b>13,4%</b>
<b>Threaded cups</b>	<b>22,4%</b>	<b>8,8%</b>
<b>Press-fit cups</b>	<b>55,5%</b>	<b>77,8%</b>

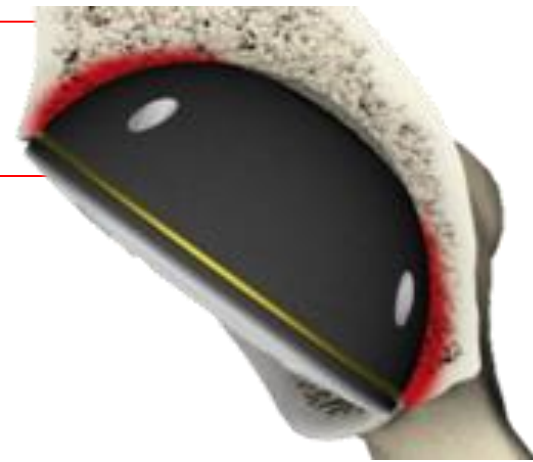
# Impact or screw in ?



- **Secondary stability** has **only press-fit acetabular cup** because covering surface is similar to structure of cancellous bone to allow bone ingrowth
- **Threaded cup** has no such surface because **we couldn't screw in it.**

Lazarinis S i wsp: Increased risk of revision of acetabular cups coated with hydroxyapatite. Acta Orthopaedica 2010; 81(1): 53–59  
 Grubl A i wsp: Cementless total hip arthroplasty with a tapered, rectangular titanium stem and a threaded cup: a minimum ten-year follow-up. J Bone Joint Surg Am. 2002; 84-A(3): 425-431

## Impact or screw in ?

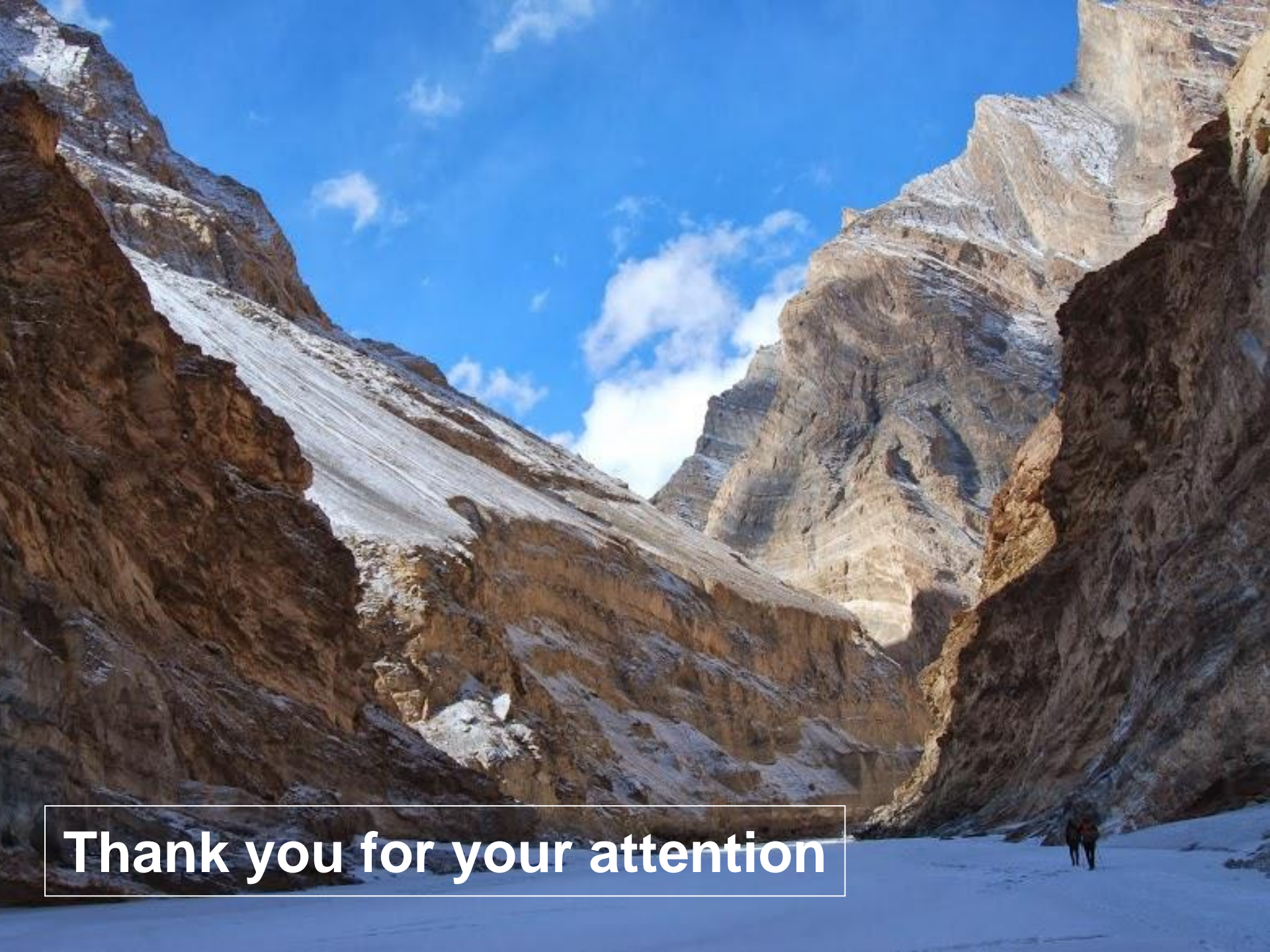


- Forces needed to insert the threaded and the press-fit cups are different:
  - screw in – it is 1500J (i.e. 1500 W. The **100W light bulb will stay lit for about 10 seconds**) or **2 KM**
  - press – fit – it is 125 J (i.e. 125 W. The **100W light bulb will stay lit for about 1,5 second**) or **0,16 KM**

## Impact or screw in ?

- Hemispherical press - fit uncemented cup is the **gold standard** in THA
- Additional stabilization with screws do not worsen the osteointegration
- Threaded cup is an alternative with high risk of aseptic loosening and the probability is greater with time
- In situation when we could implant the treaded cup we can also implant the press-fit one
- When we **cannot implant the treated cup** we certainly **could implant the press-fit cup** 😊





**Thank you for your attention**