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HIP PROSTHESIS

MODELS AND MATERIALS
SURGICAL TECHNIQUES
APPROACHES

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IMPLANT TO BONE INTERFACE

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CEMENTLESS

Grid-blasted
(Morscher Pressfit)

Threaded
(Bicon)

Porous-coated
(Pinnacle)

CEMENTED

Polished metal
(Versacem)

Polyethylene
(Müller Flachprofil)

COPING WITH BONE LOSS

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Enforcement rings

(Ganz, Burch-Schneider)

Tumor prostheses

(Link)

Trabecular metal augments

ARTICULATING SURFACES

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advantage	disadvantage
wear ↓	breakage (head)
reliable, forgiving	wear
wear ↓↓↓	squeaking breakage
wear ↓↓ stability	metal ion blood level pseudotumor

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MoM PROSTHESIS / MODULAR NECK

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Risk of:

- osteolysis

- ALVAL[1]: aseptic lymphocyte-dominated vasculitis-associated lesion

→ pseudotumor

Investigation:

- blood serum[2,3]: cobalt: > 2-7 µg/l (>119nmol/l)

chrom: >134.5 nmol/l

- CT / MARS (metal artifact-reducing sequences) MRI

1 Watters TS, Am J Clin Pathol 134: 886, 2010
2 EFFORT, Consensus statement, April 16, 2012
3 MHRA UK. Medical device alert. Metal-on-metal total hip replacements. 2012 Apr

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MANAGEMENT

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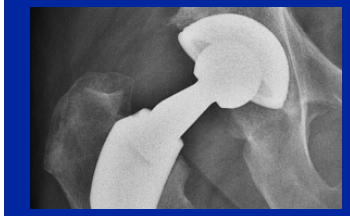

Table 1 - Management recommendations for patients with stemmed MoM total hip replacements – femoral head diameter ≥36mm (originally published in the MHRA's MDA/2012/008).

	Stemmed MoM total hip replacements – femoral head diameter ≥36mm	
	Symptomatic patients	**Asymptomatic patients**
Patient follow-up	Annually for life of implant	Annually for life of implant
Imaging: MARS MRI or ultrasound	Recommended in all cases	Recommended if blood metal ion levels rising
1st blood metal ion level test	**Yes**	**Yes**
Results of 1st blood metal ion level test	*Blood metal ion level >7ppb indicates potential for soft tissue reaction*	*If blood metal ion level >7ppb then second blood test required 3 months later*
2nd blood metal ion level test	**Yes** - 3 months after 1st blood test if result was >7ppb	**Yes** – 3 months after 1st blood test if result was >7ppb
Results of 2nd blood metal ion level test	*Blood metal ion level >7ppb indicates potential for soft tissue reaction especially if greater than previously*	*If blood metal ion levels rising - further investigation required including imaging*
Consider need for revision	If imaging is abnormal and/or blood metal ion levels rising	If imaging is abnormal and/or blood metal ion levels rising

Table 1 footnotes:

- Blood metal ion testing to be in whole blood.
- 7 parts per billion (ppb) equals 119 nmol/L cobalt or 134.5 nmol/L chromium.

MHRA UK. Medical device alert. Metal-on-metal total hip replacements. 2012 Apr

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PRIMARY STEMS

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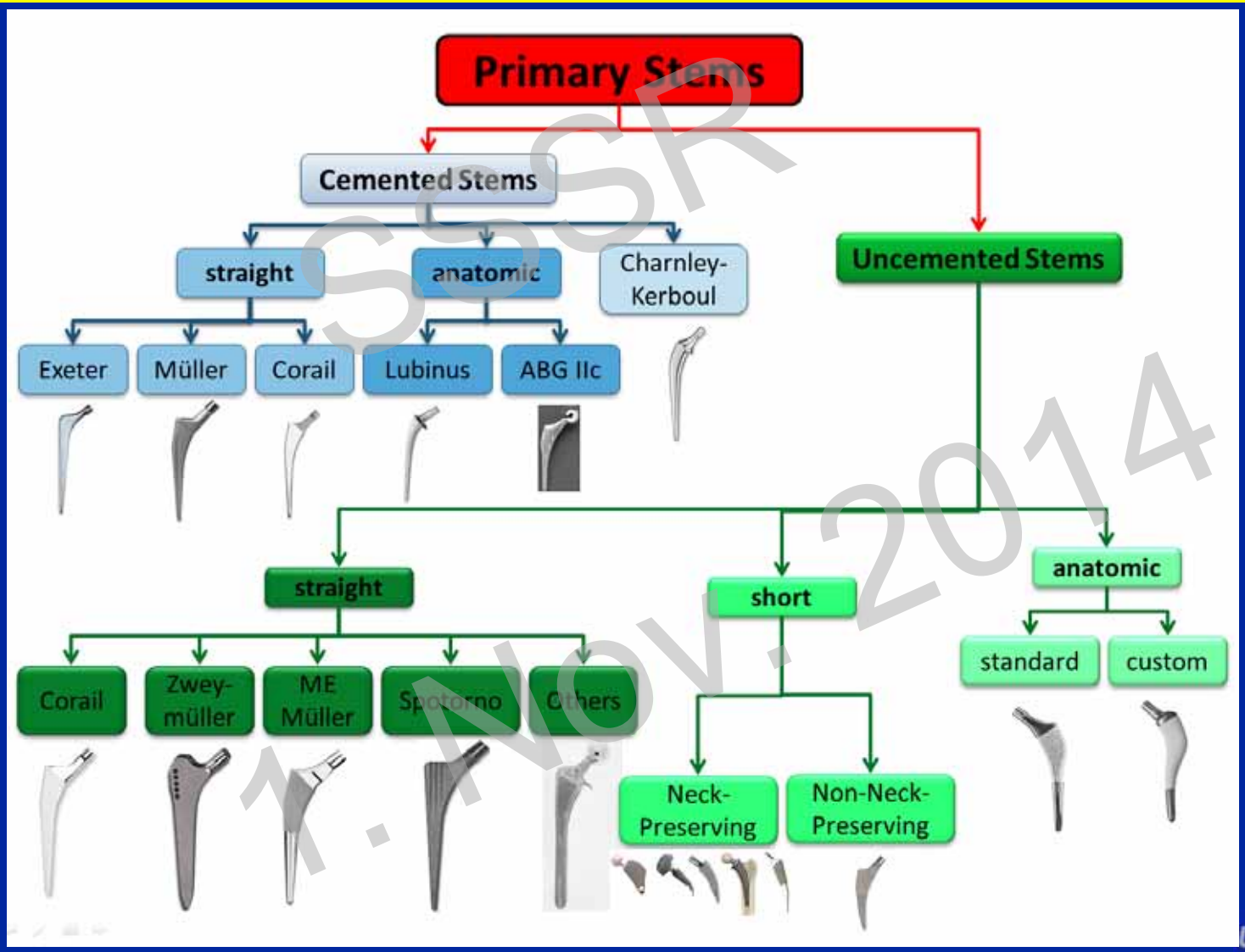

courtesy H. Rüdiger , CHUV 2013

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TRENDS IN FIXATION OF PRIMARY THR

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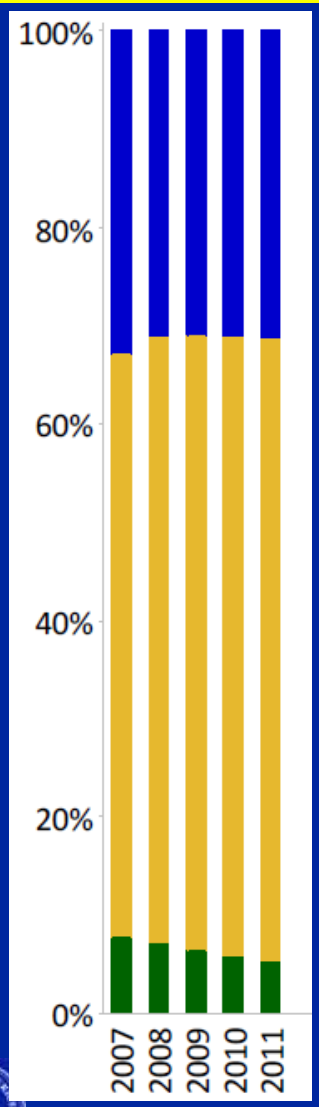
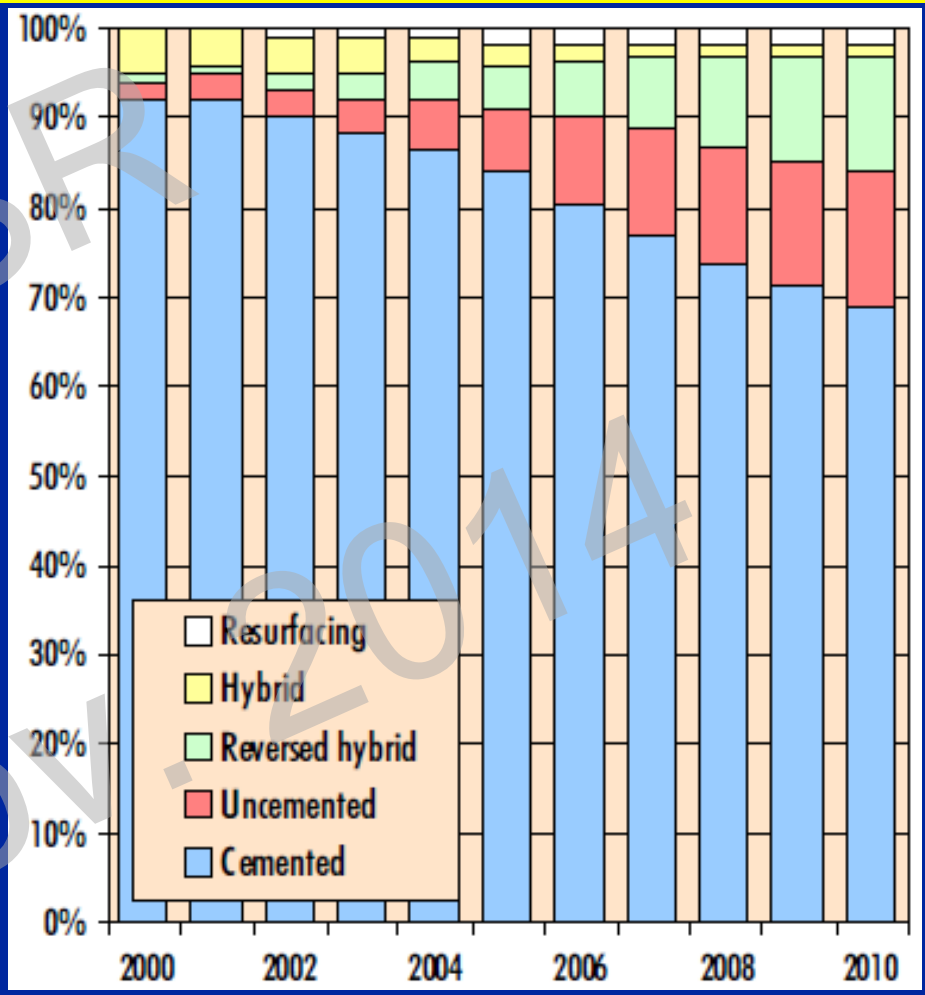


← Hybrid

← Cementless

← Cemented



Australian Joint Replacement Registry 2012

Swedish Joint Arthroplasty Registry 2010

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CEMENTLESS FIXATION

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Inital mechanical stability

- shape
- oversize
- strength and stiffness

Surface features relating to biocompatibility and bone attachment

- ingrowth: sintered beds, fiber mesh, porous metal
- ongrowth: grit blasting, plasma spraying

Khanuja H, JBSJ A, 93:500, 2011

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MODULAR STEM DESIGN

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Modularity allows a more accurate reconstruction

- how much accuracy is needed?
- better functional outcome?
- risk: breakage, fretting corrosion

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ANATOMICAL STEM - SPS

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More antamomic canal filling shape:

- less stress shielding?
- better functional outcome?
- superior survivalship?

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CUSTOM-MADE STEMS

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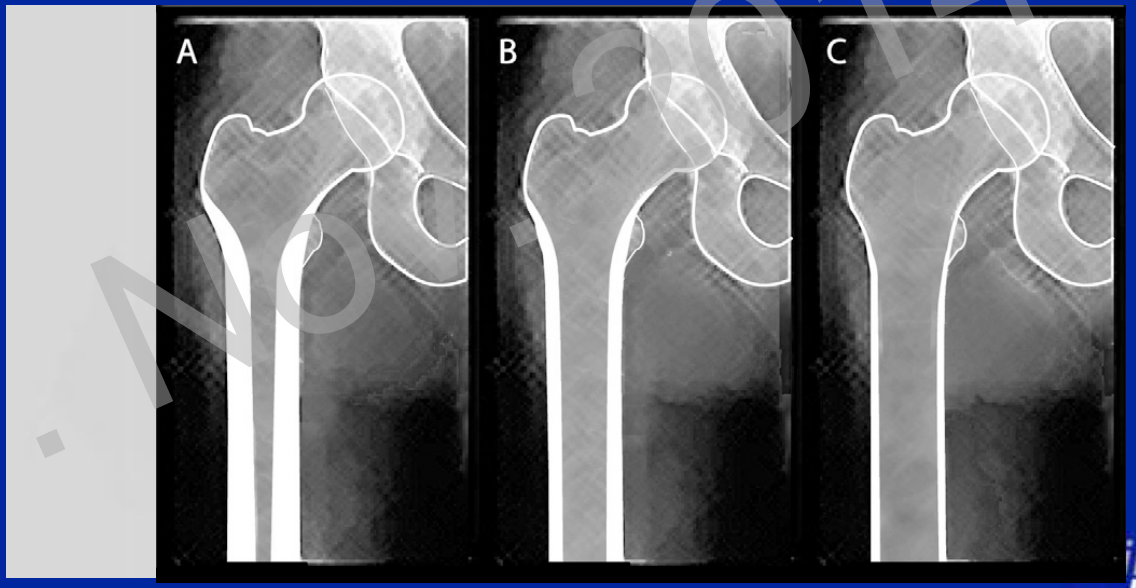
complex and unusual intra-medullary anatomy

gross extra-medullary deformity

high costs

(alternative: cemented stem)



MATERIAL

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TABLE 7-2
APPLICATION OF BIOMATERIALS TO CONTEMPORARY THR ARTHROPLASTY COMPONENTS

ASTM Designation	Common Name	Articular	Structural	Fixation	Articular	Structural	Fixation
Metals							
F-67	CP Ti	—	√	√[a]	—	—	√[a]
F-75	Cast CoCr	—	√	√	√	√	√
F-90	Wrt. CoCr	—	√	√	√	√	√
F-136	Ti6Al4VELI	—	√	√	—	√	√
F-560	Tantalum	—	√	√[a]	—	—	√[a]
F-562	MP35N	—	√	—	—	√	—
F-563	[illegible]	—	√	—	—	√	—
F-1295	[illegible]	—	√	—	—	√	—
F-1314	High N SS	—	—	—	√[b]	√[b]	—
F-1472	Wrought Ti6Al4V	—	√	—	—	√	—
F-1537	Wrought CoCrMo	√	√	—	√	√	—
F-1713	[illegible]	—	√	—	—	√	√
F-1813	[illegible]	—	√	—	—	√	√
F-2066	Wrought Ti15Mo	—	√	√	—	√	√
F-2384	Zr2.5Nb	—	—	—	√[d]	√[c]	—
Polymers							
F-451	PMMA	—	—	√	—	—	√
F-648	UHMWPE	√	√	—	—	—	—
F-1579	PAEK	—	—	—	—	—	√[a]
Ceramics							
F-603	Aluminum oxide (alumina Al_2O_3)	√	√[b]	—	√	√[c]	—
F-1185	Hydroxylapatite (CaHAP)	—	—	√	—	—	√
F-1873	Zirconium oxide, yttria stabilized (zirconia-ZrO_2-Y-TZP)	√[b]	√[b]	—	√[b]	√[b]	—
F-2393	Zirconium oxide, magnesia stabilized (zirconia-ZrO_2-Mg-PSZ)	√[b]	√[b]	—	√[b]	√[b]	—

[a]Applied to a different metal alloy substrate (e.g., F-136, F-1472).
[b]Not in use in the United States, but in use elsewhere.
[c]Used as a modular component on metal alloy stem (e.g., F-90).
[d]Used in articulation only with UHMWPE.

- Titanium-aluminium-vanadium alloy

- Cobalt-chromium-molybdenum alloy

Callaghan, The Ault Hip, LWW, 2007

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SURGICAL APPROACHES

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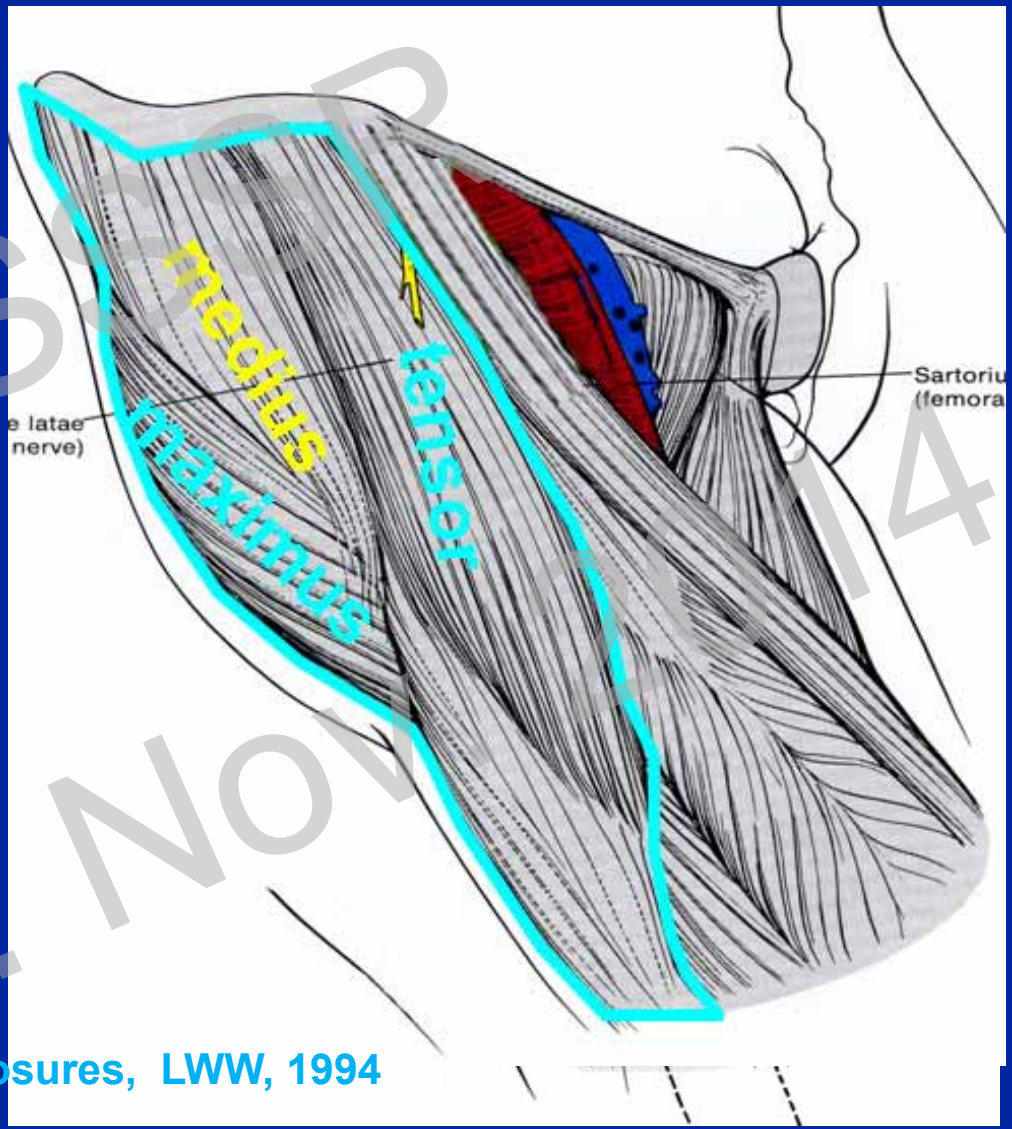
- anterior

  anterolateral
- lateral

  posterolateral
- posterior



Hoppenfeld, Surgical Exposures, LWW, 1994

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„minimally invasive hip arthroplasty..

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..is clearly open to interpretation.

It may reflect..

..the size of incision

..the aim to minimize trauma to muscles

..change in pain management and physical therapy protocols

..attitude concerning the length of time recovery should take.“

Wall SJ, Arthroplasty; 23 Suppl 1: 55, 2008

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„..the size of incision..”

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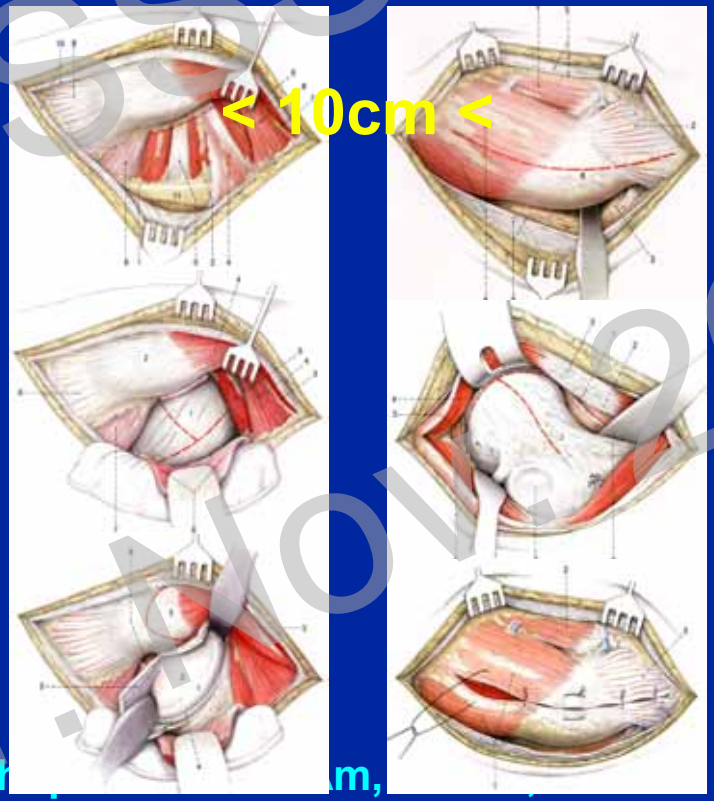
„minimal-invasiv“

versus

< 10cm <



„conventional“

Hartzband MA, Orth[illegible]m,

Dorr LD, JBJS Am, 89:1153, 2007

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„..the size of incision..”

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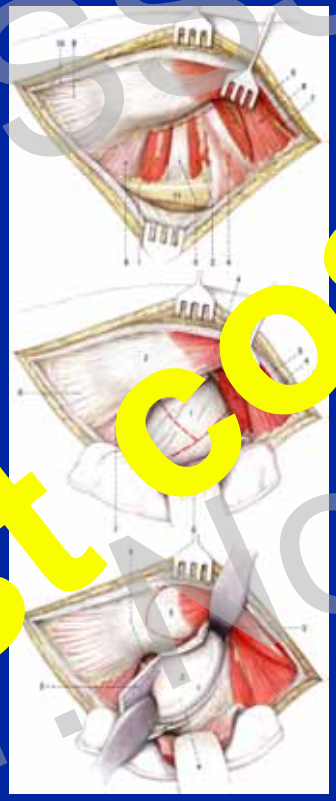
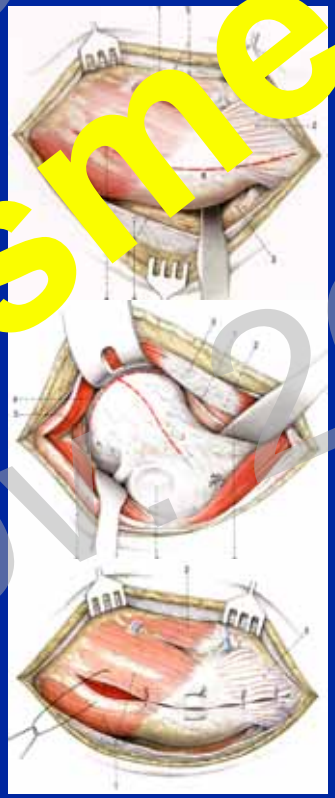
versus





„minimal-invasiv“

„conventional“

„just cosmetics“

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„...the aim to minimize trauma to muscles ..”

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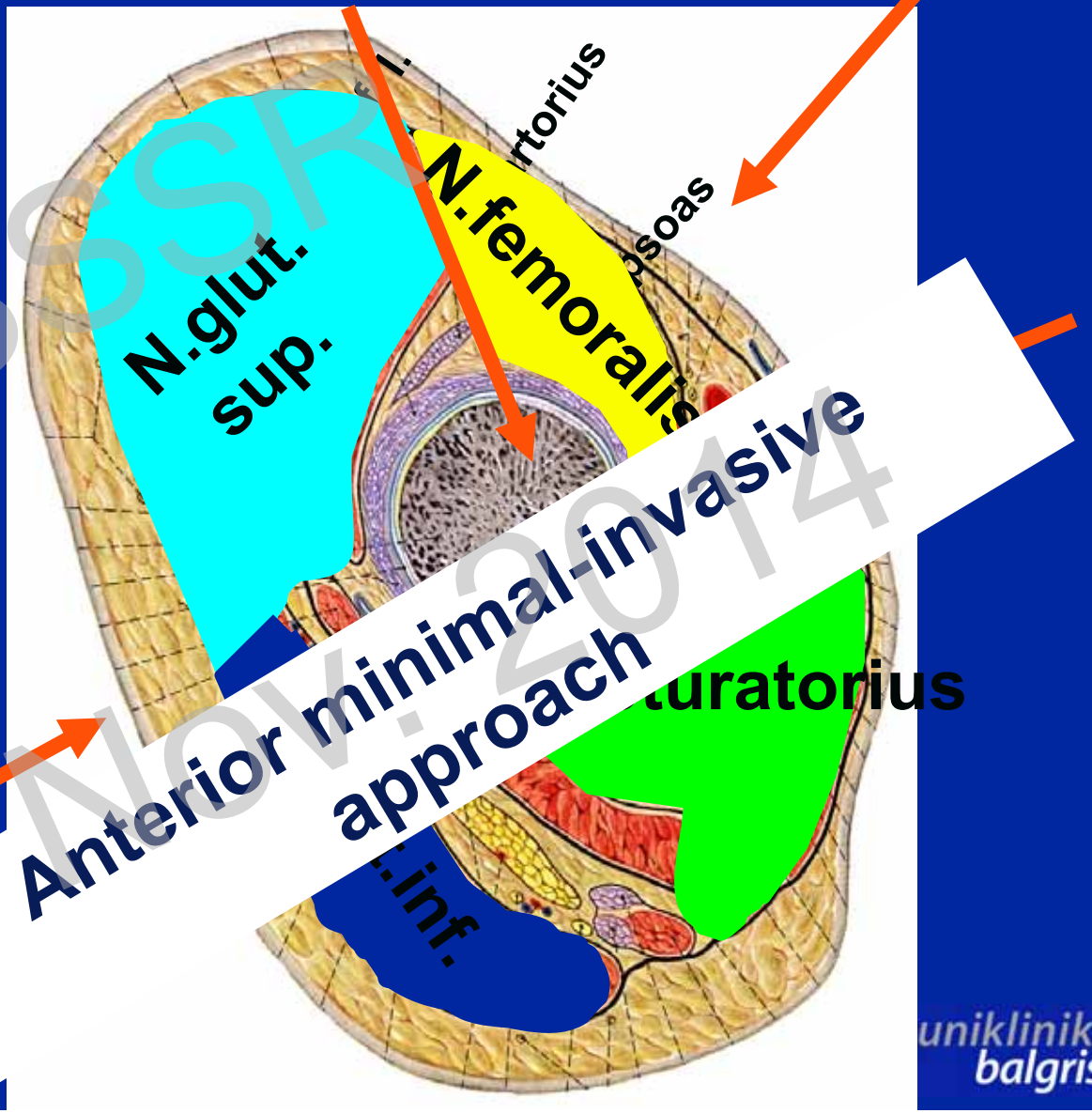
- shortest way
- intermuscular
- internervous



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MINIMAL-INVASIVER ANTERIORER ZUGANG

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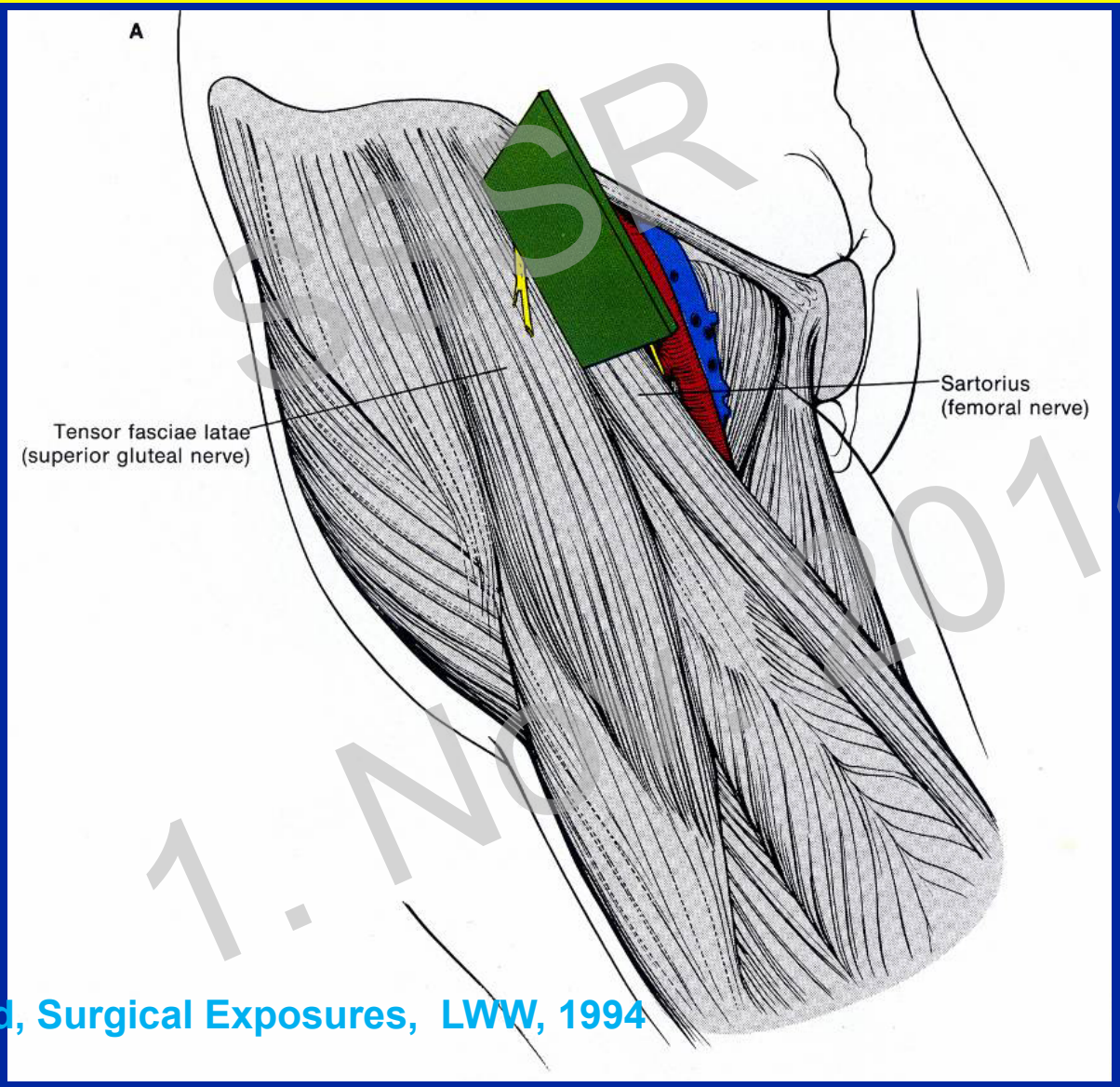

Hoppenfeld, Surgical Exposures, LWW, 1994

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TEMPLATING

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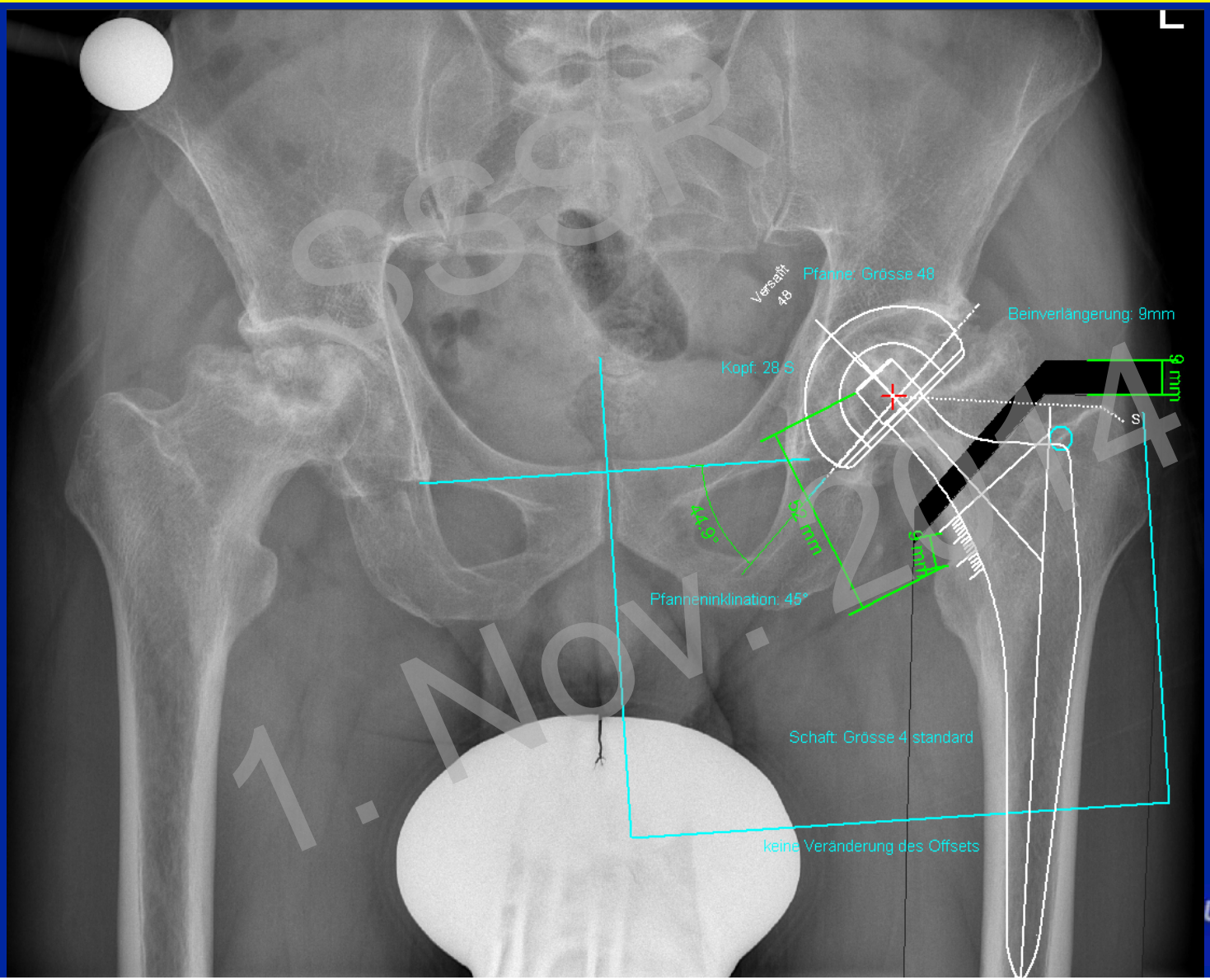

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LEG HOLDER

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AVOID THE LAT. CUTANEOUS NERVE

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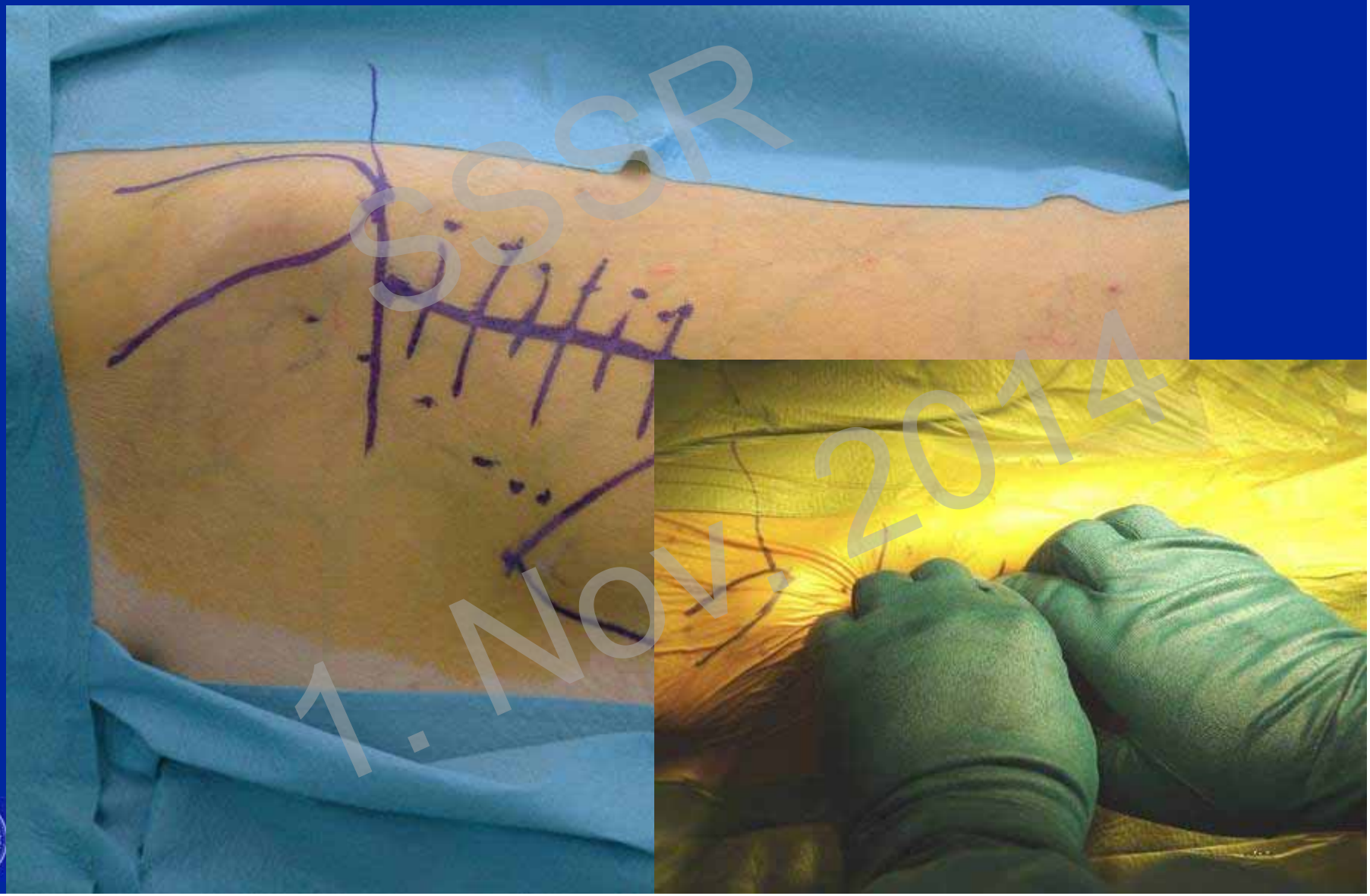

DRAPING

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INCISION

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ENTER FASCIAL SHEAT

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RETRACT TFL LATERALLY

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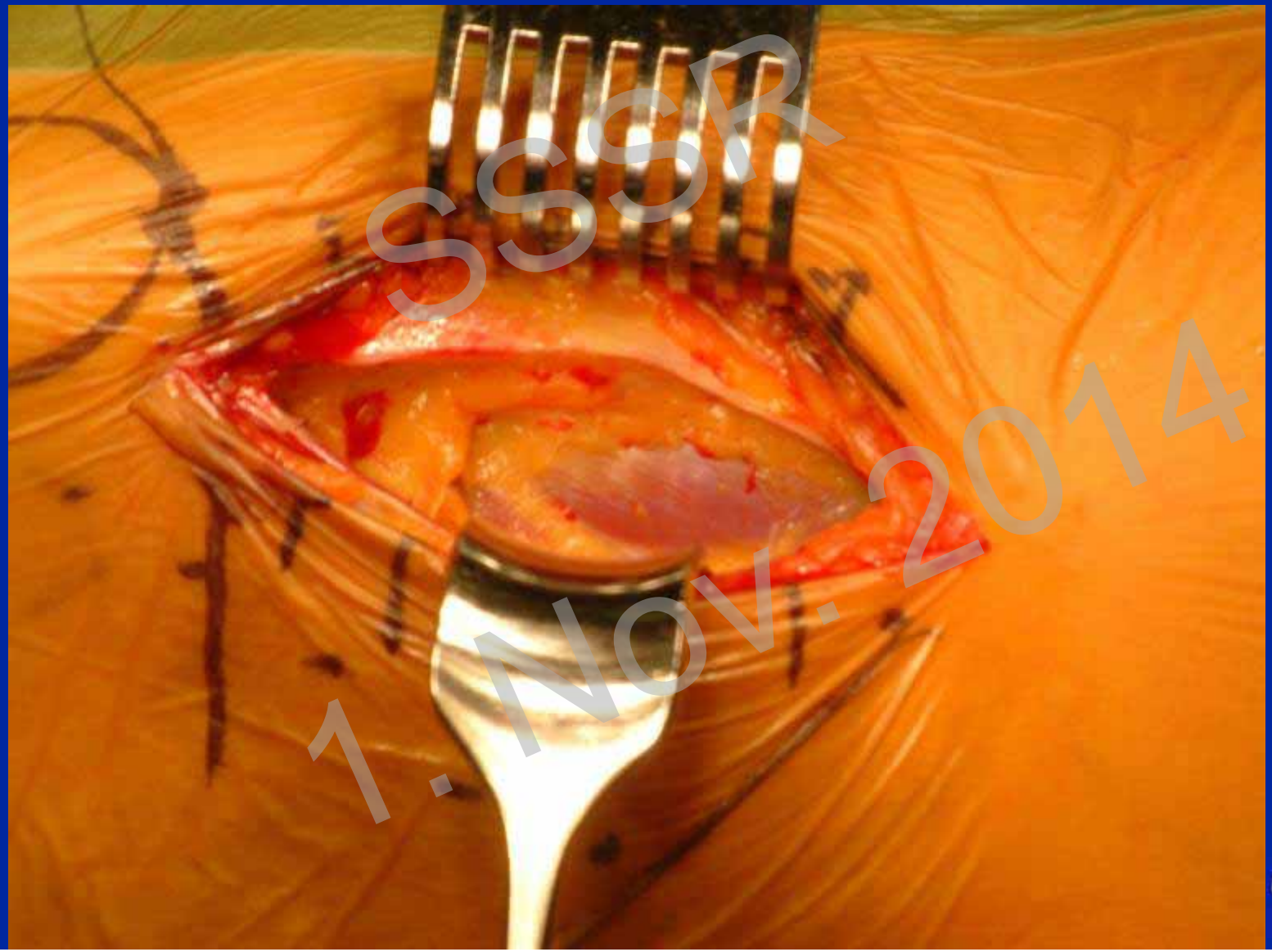

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MOBILIZE RECTUS FEMORIS

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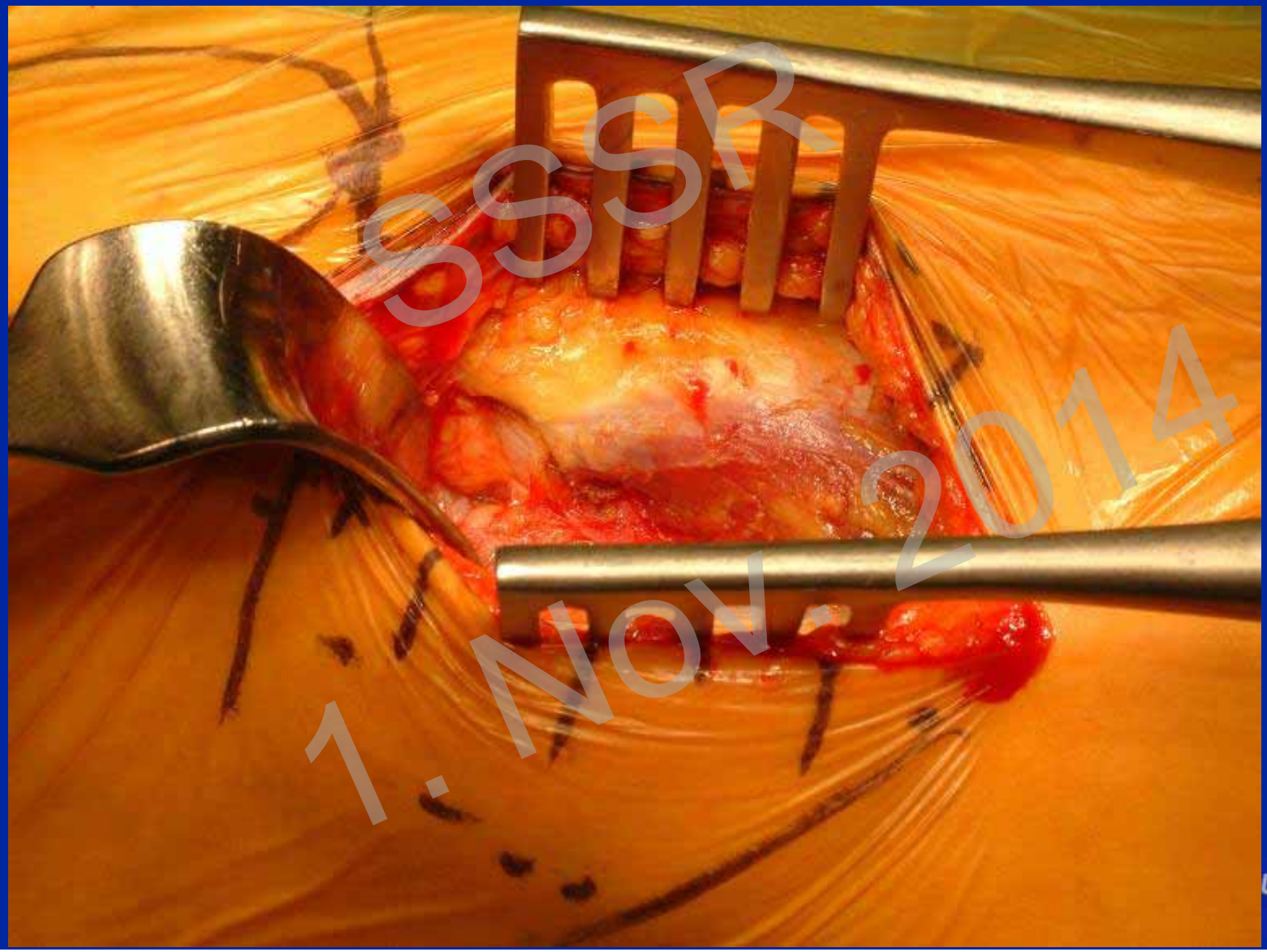

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LIGATE AND COAGULATE

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EXPOSE CAPSULE

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INSTRUMENTALIZE THE CAPSULE

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INTRACAPSULAR RETRACTOR

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SAW

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TRACTION

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EXTRACTION OF FEMORAL HEAD

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REAMER

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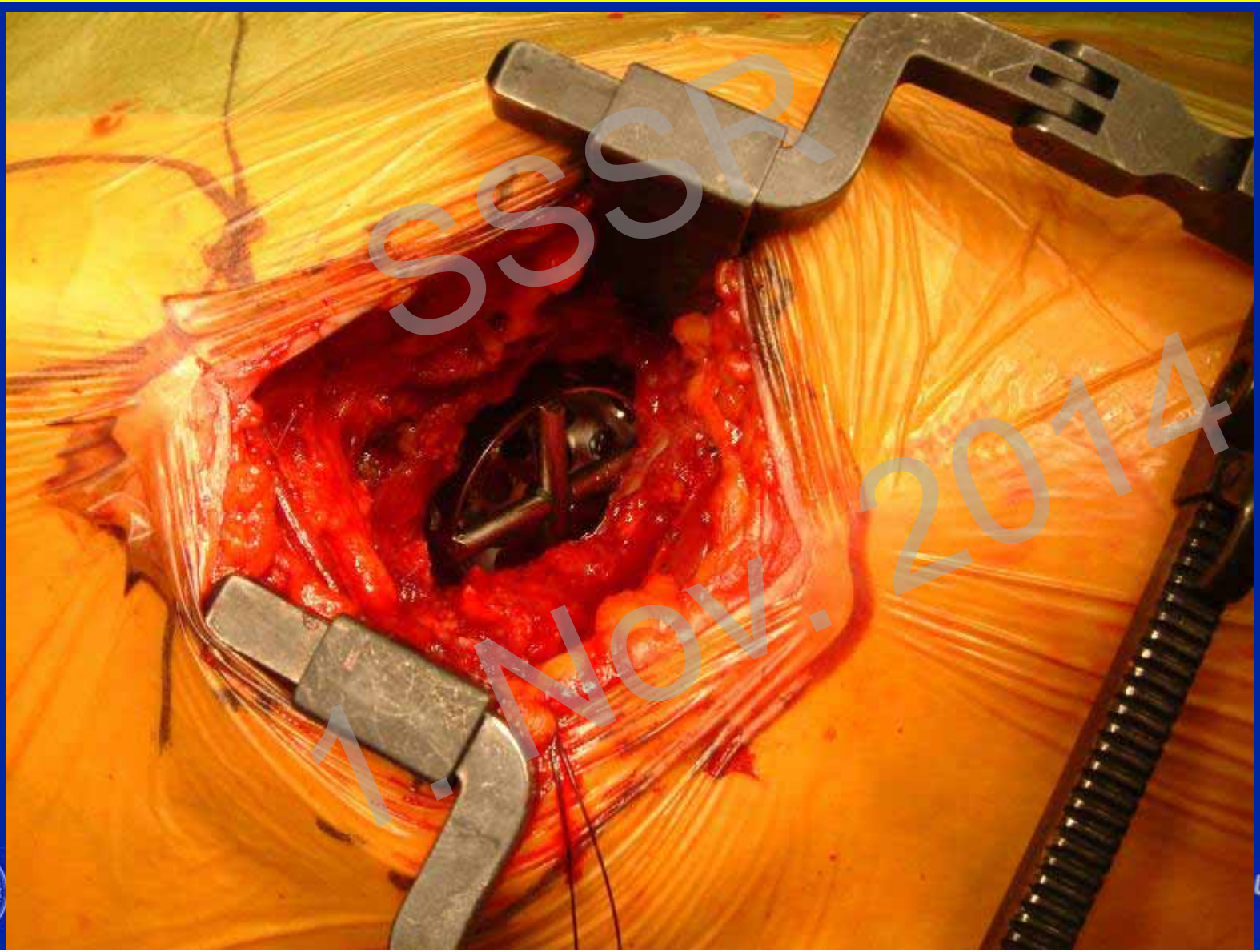

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REAMER

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CHECK POSITION AND RESECT POSTERIOR OSTEOPHYTES

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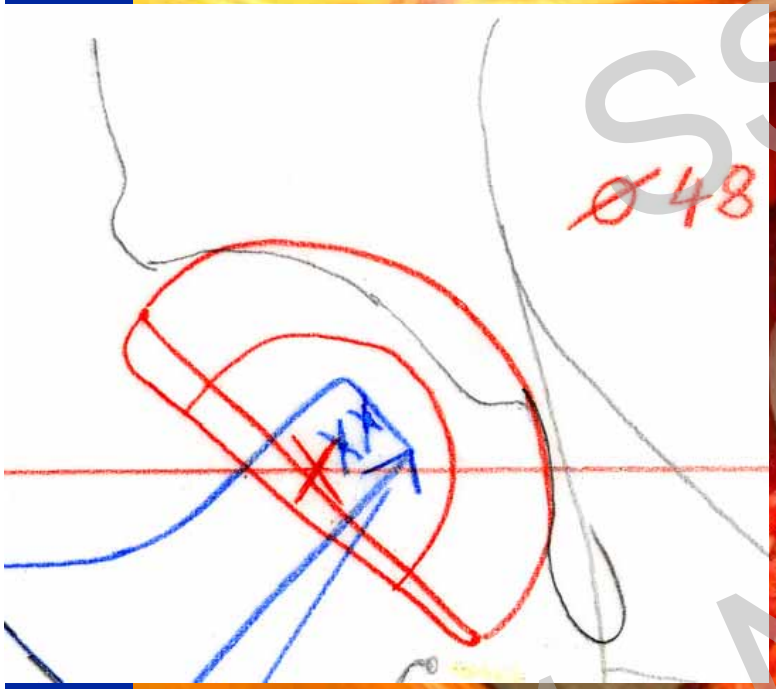

PULL

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90° OF EXTERNAL ROTATION

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EXTENSION

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EXPOSURE OF FEMUR

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BROACH

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CHECK LEG LENGTH

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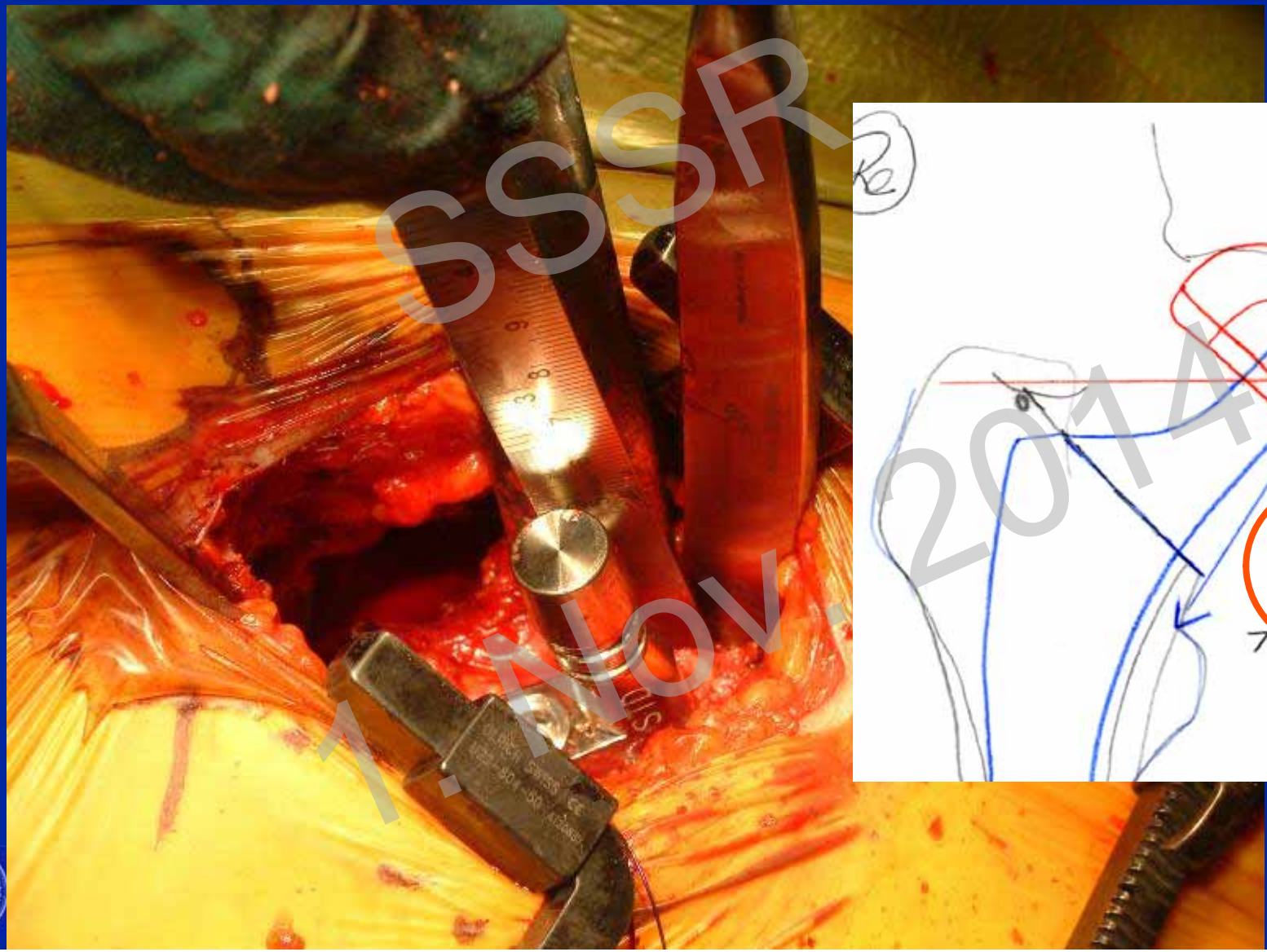

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IMPLANT THE STEM

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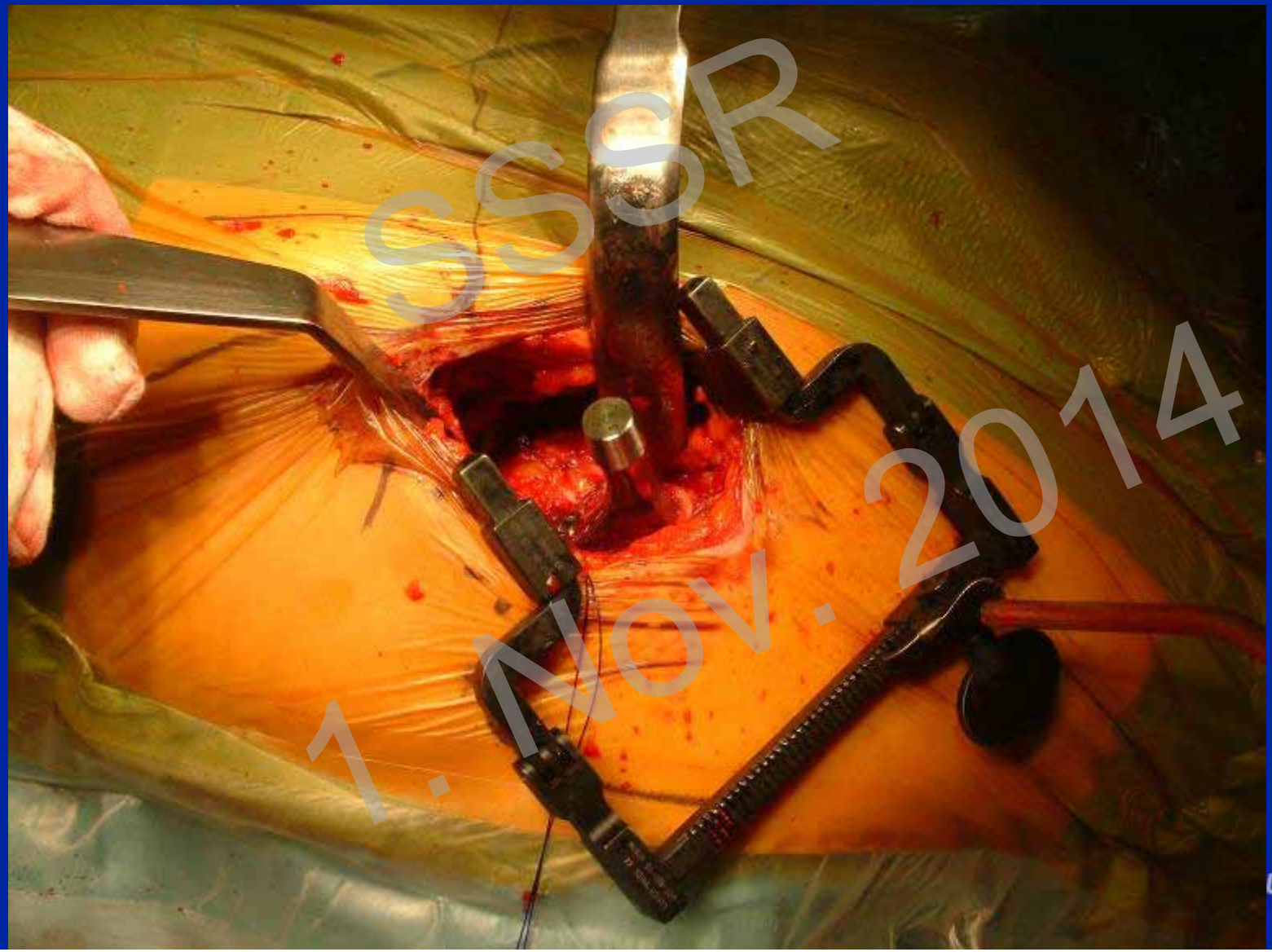

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CHECK STABILITY

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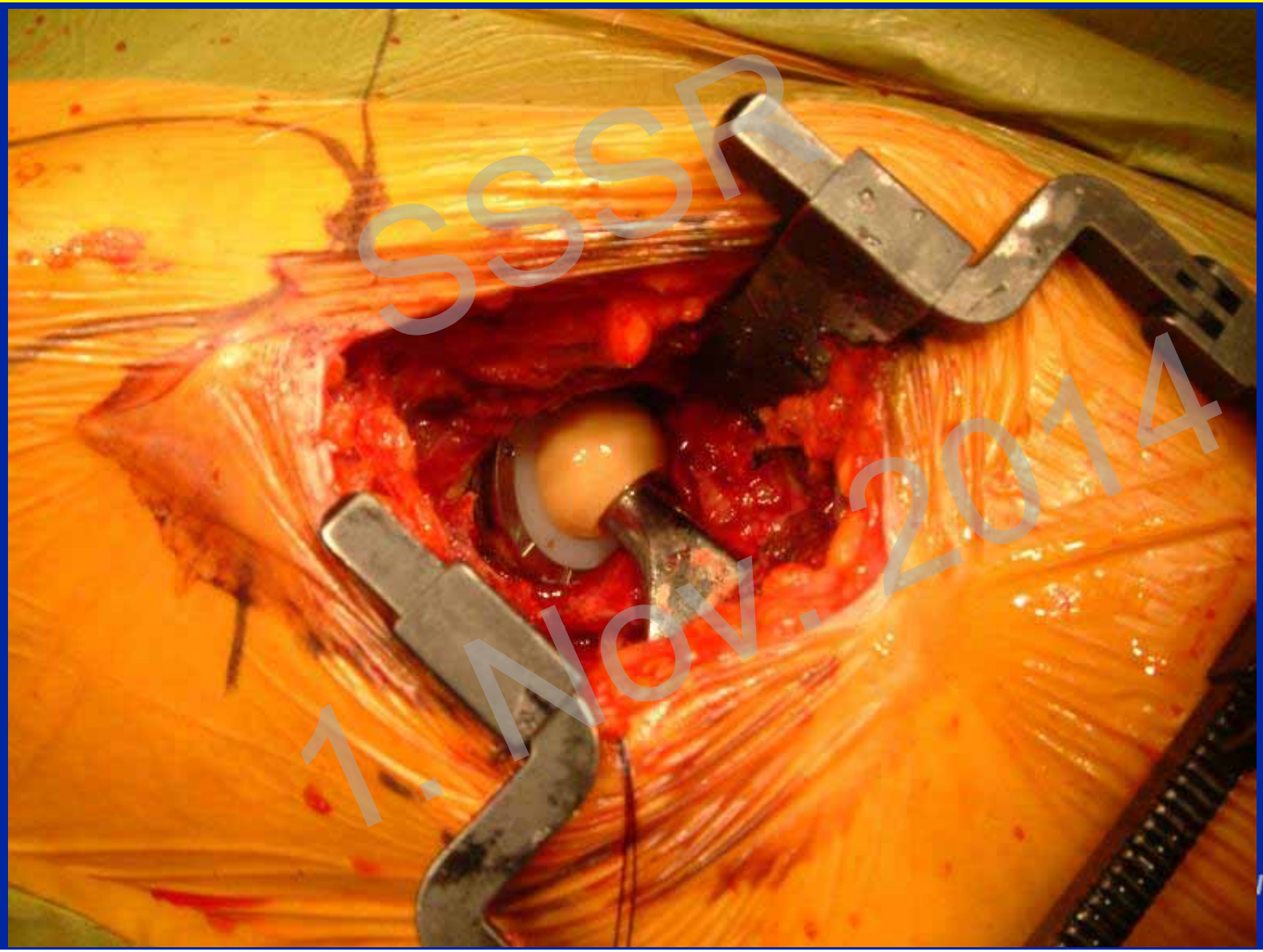

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READAPT THE CAPSULE

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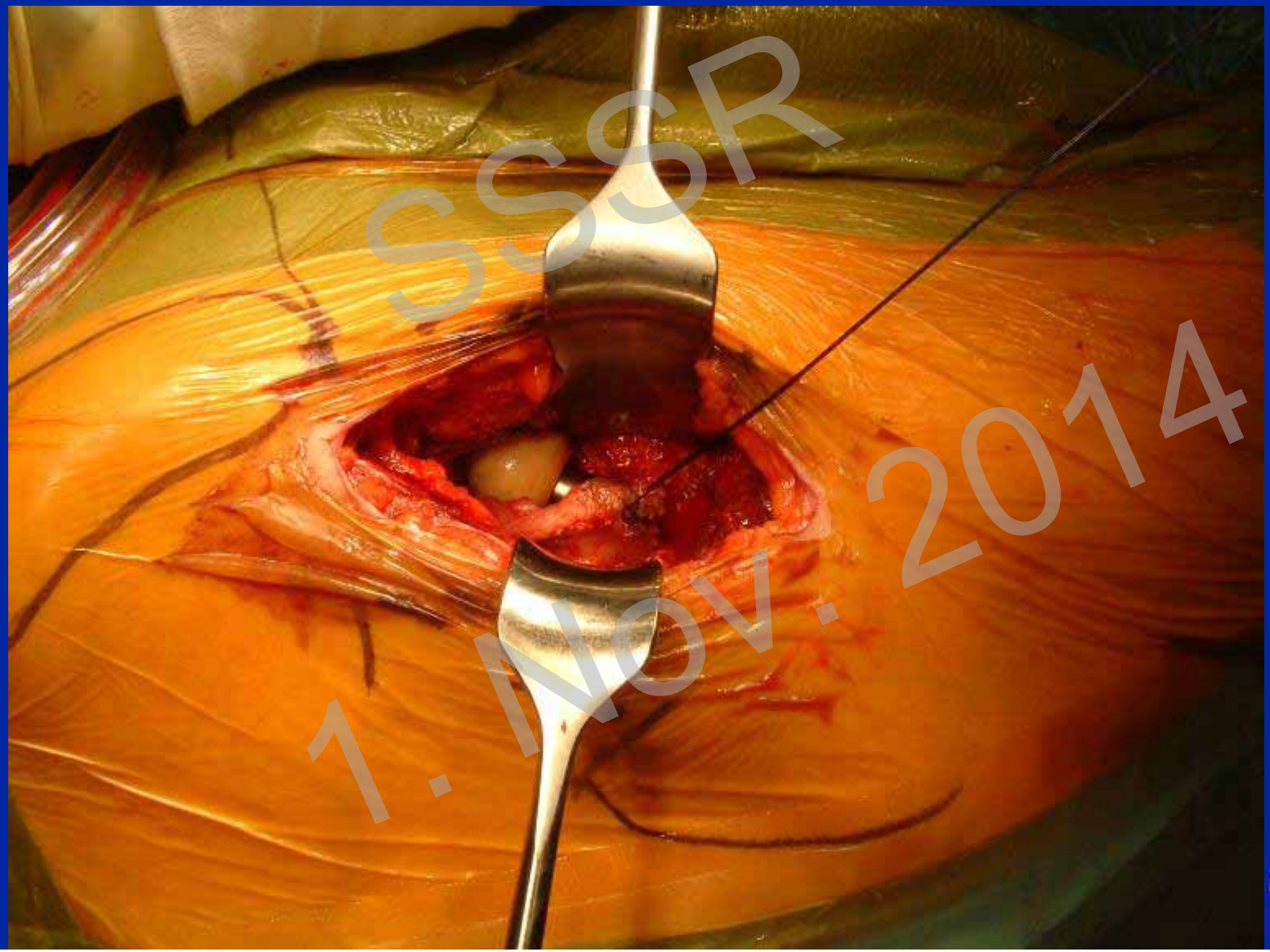

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CLOSE FASCIA

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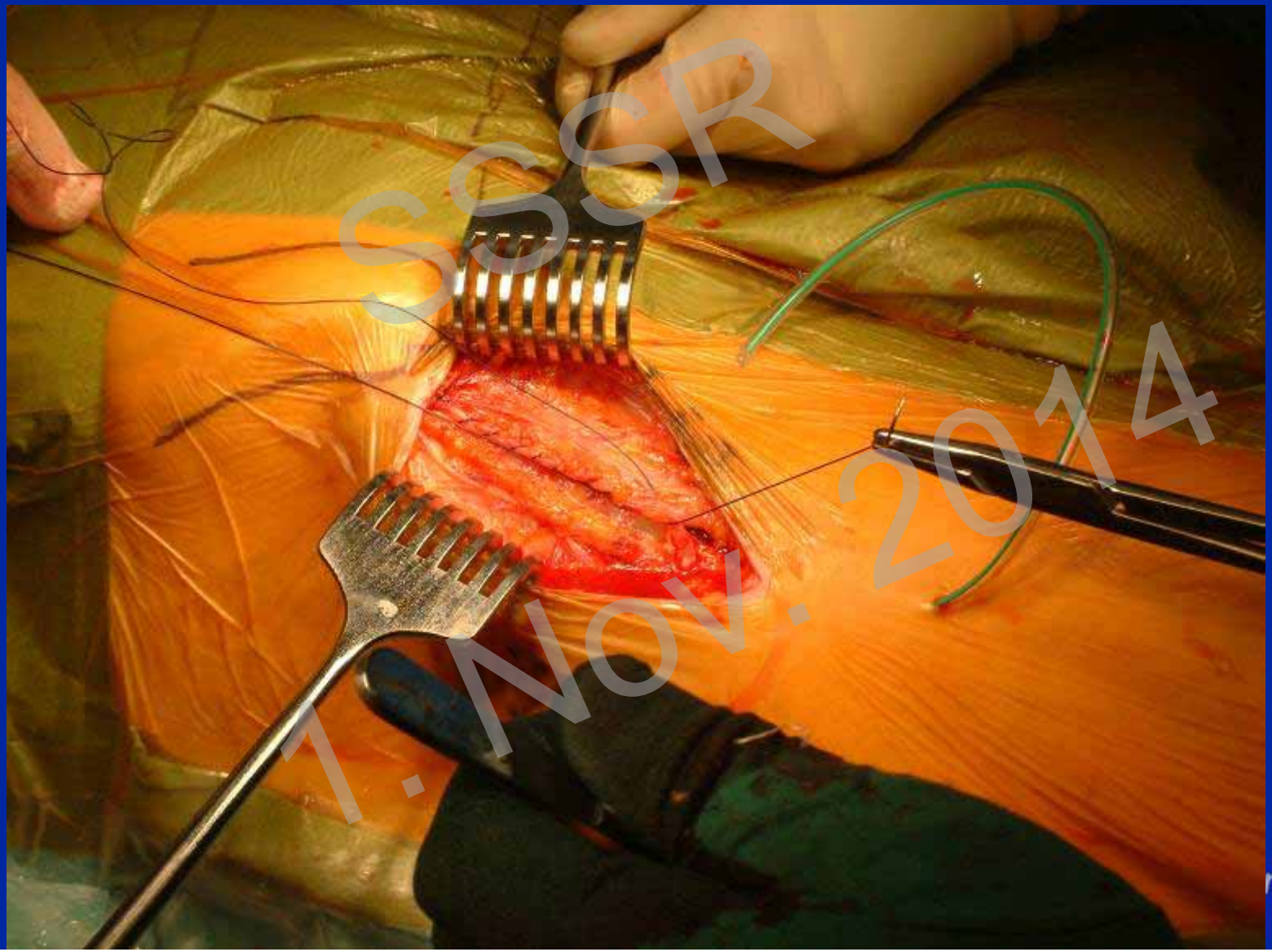

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RESULT

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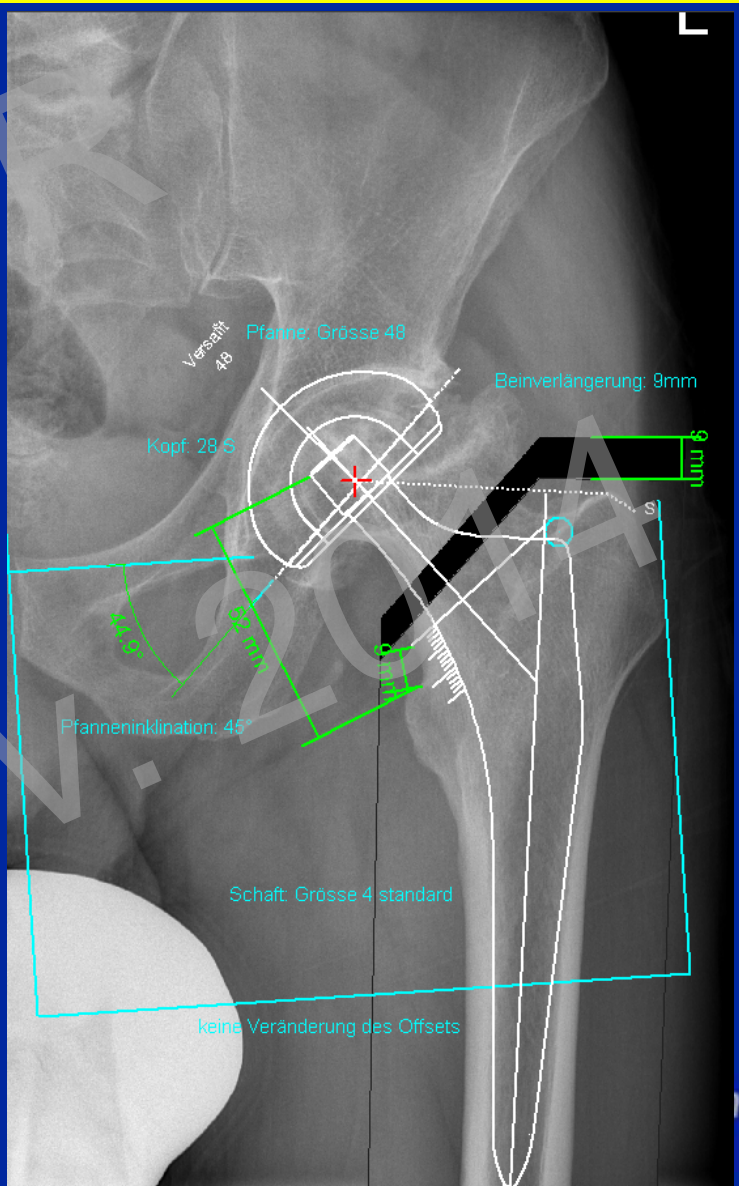

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ANTERIOR APPROACH

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standard approach primary THR

full weight bearing

advantages: less muscel damage, fast rehabilitation, low dislocation rate

Limits: stem revision

Bremer A, JBJS Br, 93:886, 2011

Bergin P, JBSJ A, 93:1392, 2011

Alecci, J Orthop Traumatol, 12:123, 2011

Sariali F, J Arthroplasty, 23:266, 2008

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TRANSGLUTEAL APPROACH

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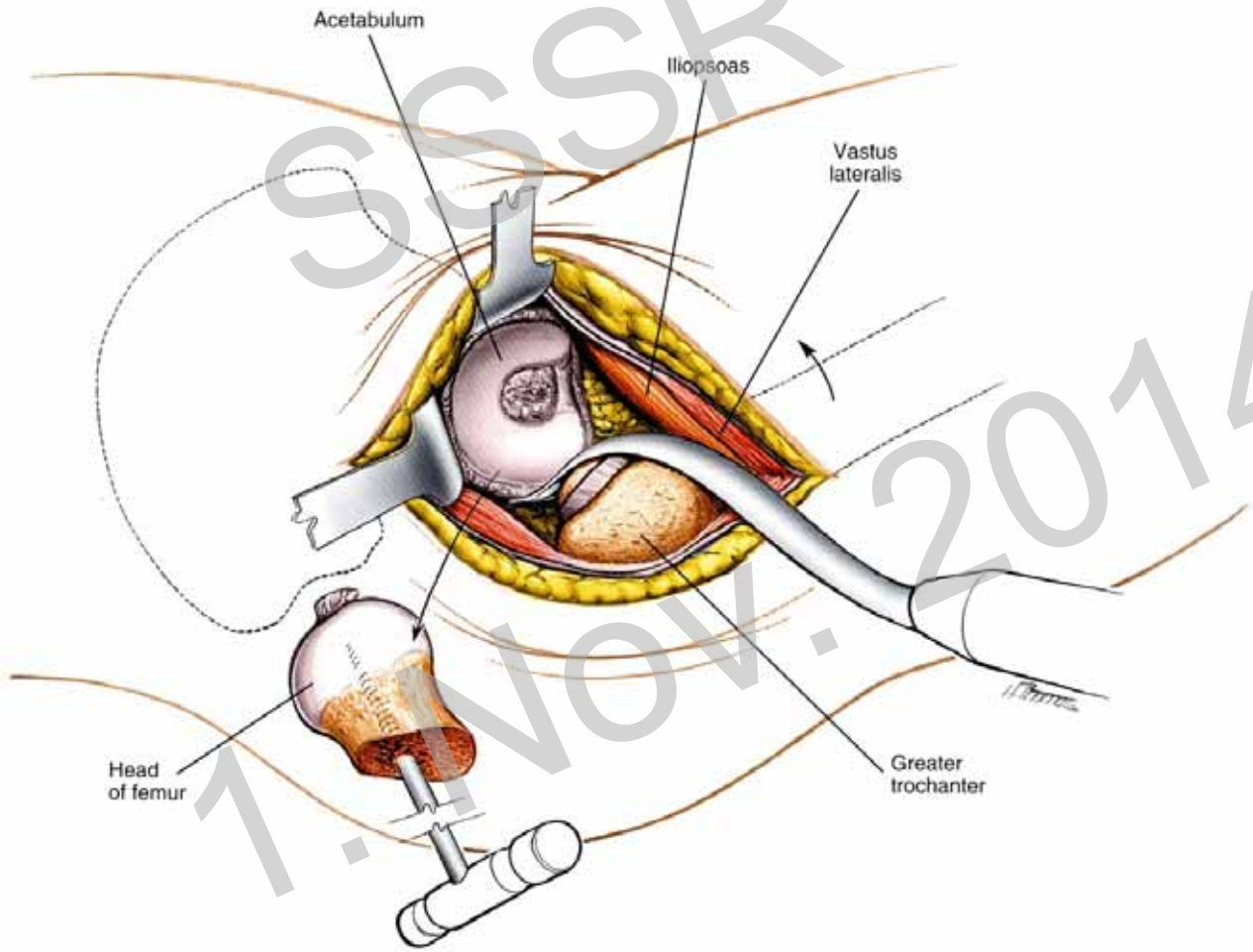

Hoppenfeld, Surgical Exposures, LWW, 2009

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TRANSGLUTEAL APPROACH

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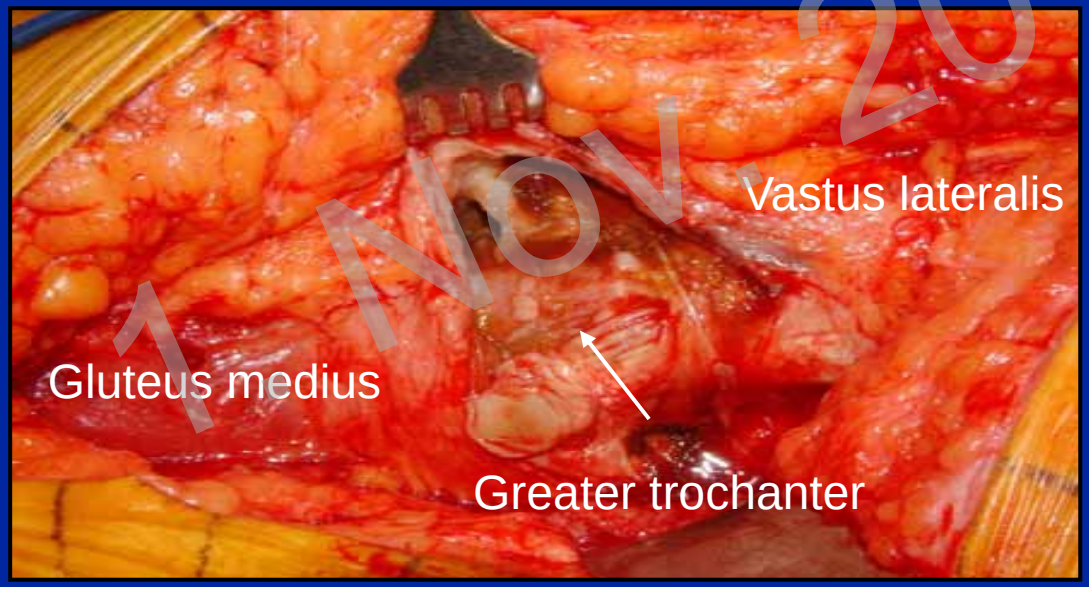
THR with revision of abductor tendons

6 weeks: partial weight bearing, no deep flexion, no acitve abduction, no passive adduction



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POSTERIOR APPROACH

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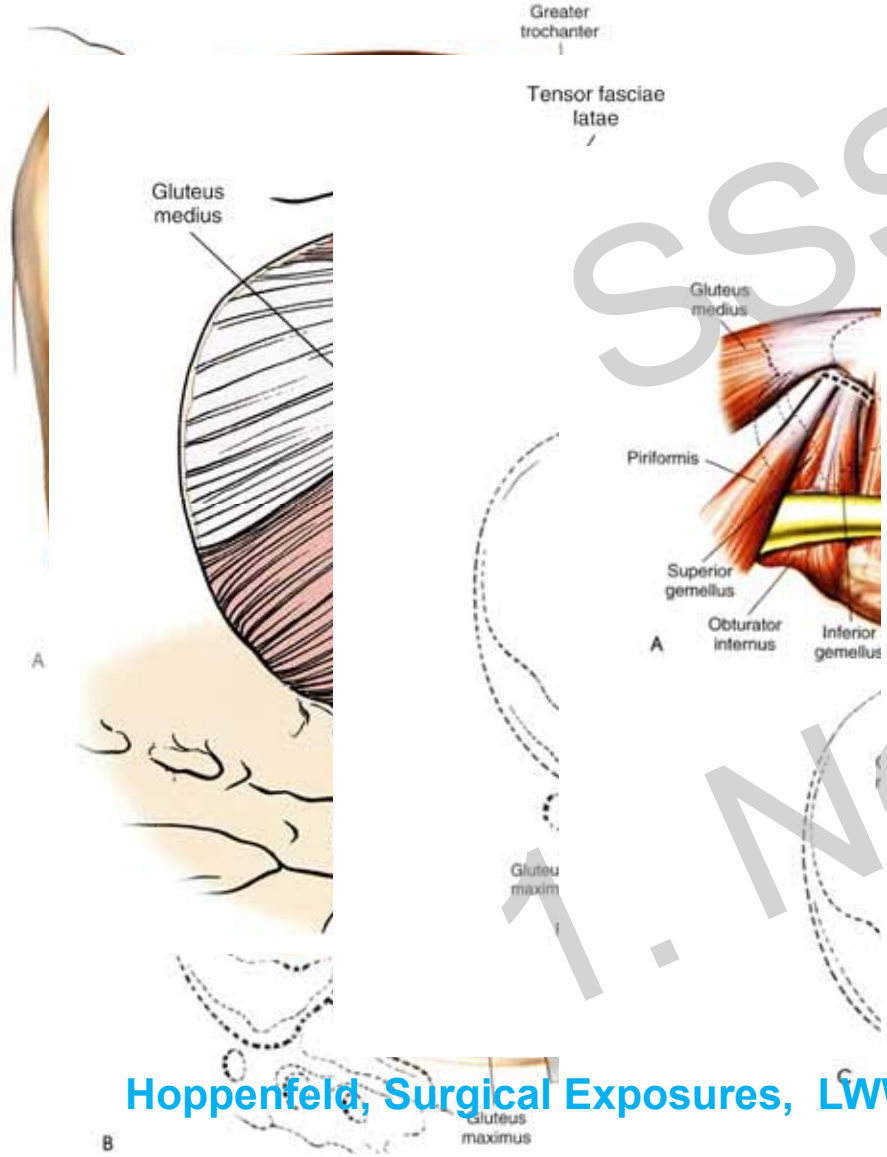

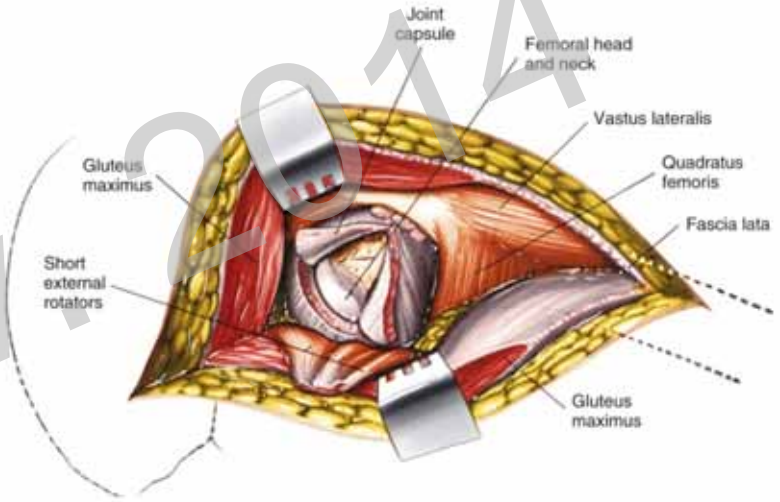

Hoppenfeld, Surgical Exposures, LWW, 2009

POSTERIOR APPROACH

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revision arthroplasty

6 weeks: no deep flexion, no
flexion/internal rotation/adduction

advantage: very versatile

(→ repair of hip abductors)

→ diagastric trochanteric OT

→ extended trochanteric OT

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DIGASTRIC TROCHANTERIC OSTEOTOMY

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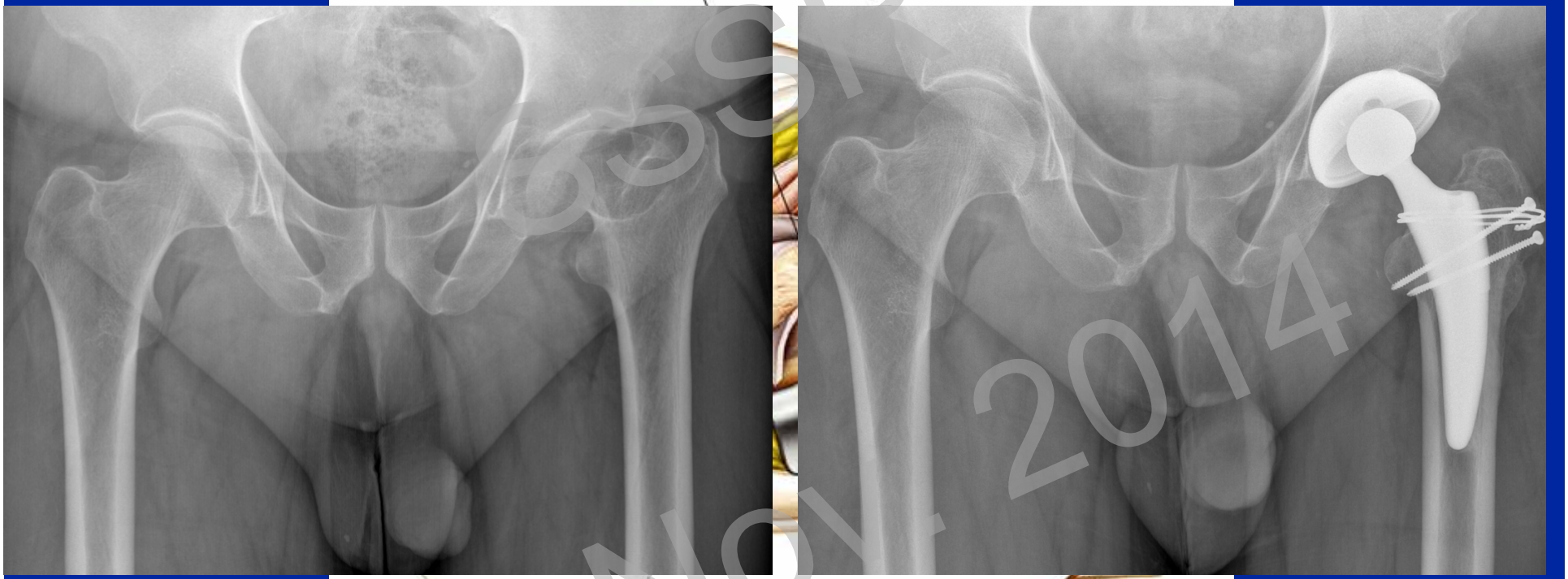

Hoppenfeld, Surgical Exposures, LWW, 2009

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EXTENDED TROCHANTERIC OSTEOTOMY

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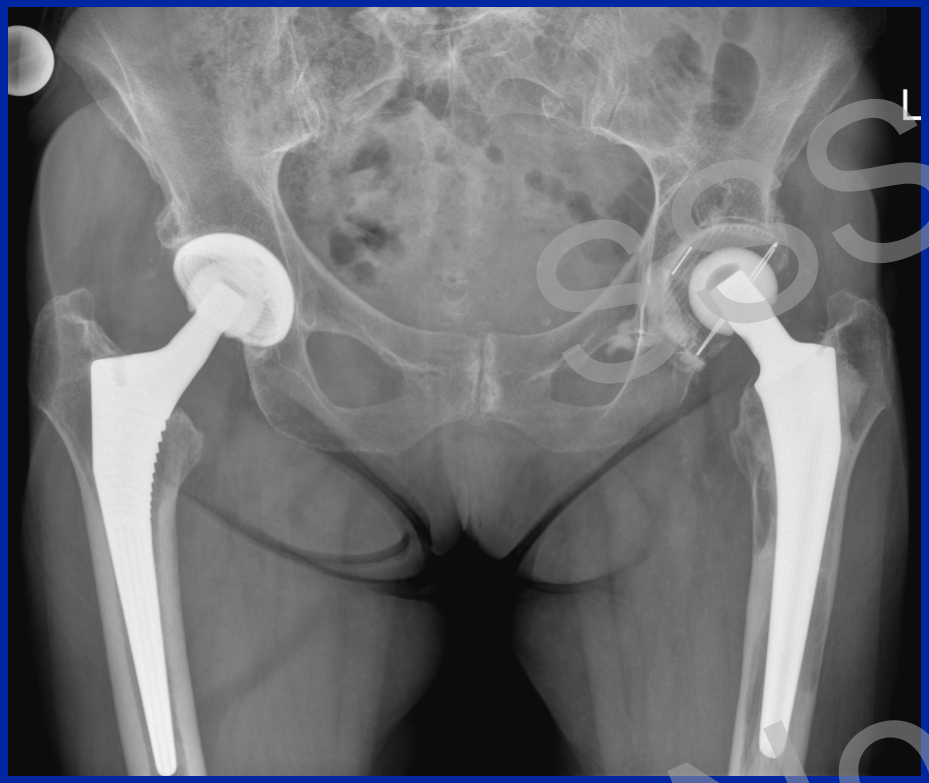

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SUMMARY

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majority of THR uncemented, not yet proven to be superior to cemented

no perfect bearing surface

anterior approach widely used for primary THR

posterior approach very versatile

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1. Nov. 2014

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