DODICESIMO CONVEGNO DI TRAUMATOLOGIA CLINICA E FORENSE

19° Corso di Ortopedia, Traumatologia e Medicina Legale

LE CAUSE DI INSUCCESSO IN ORTOPEDIA E IN MEDICINA RIABILITATIVA: DAL PLANNING AL CONTENZIOSO

PROBLEMATICHE GIURIDICHE E MEDICO LEGALI
LA DIFFICOLTA' APPLICATIVA DELLA LEGGE GELLI-BIANCO

Presidenti
F.M. Donelli, M. Gabbrielli, G. Varacca

4 - 5 Novembre 2022
Palazzo dei Congressi - Salsomaggiore Terme (PR)

patrocinio SIOT

L'INSUCCESSO NELLA CHIRURGIA PROTESICA DEL GINOCCHIO

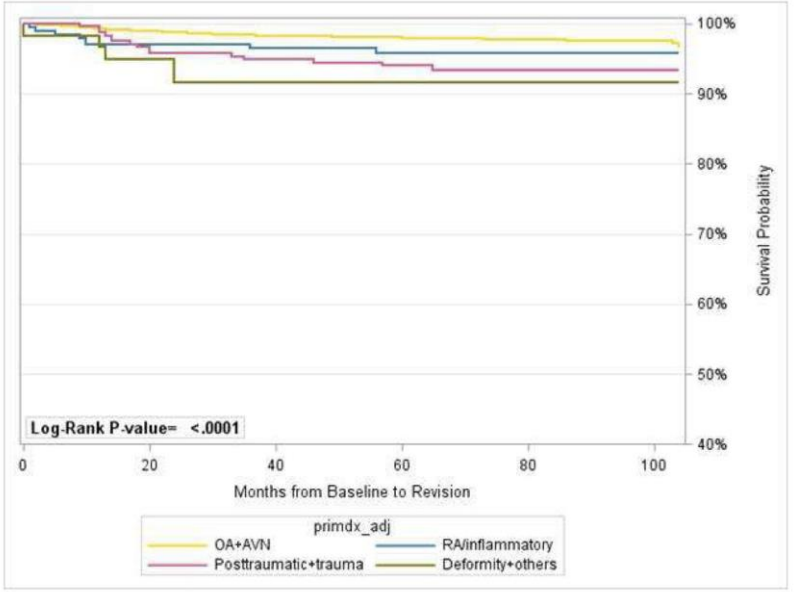
Aldo Ampollini, Paolo Adravanti,
Clinic "Città di Parma", Parma - ITALY

SIGASCOT

HUMANITAS
RESEARCH HOSPITAL

RISK FACTORS FOR TKA FAILURE

- Younger age
- Original diagnosis of post-traumatic osteoarthritis
- History of drug abuse
- Simultaneous bilateral TKA surgery
- Use of a constrained (CCK) implant



Pitta et al. J Arthroplasty 2018

MECHANISMS OF TKA FAILURE

Long-term failure mechanisms

10 to 15 years or more

Short-term failure mechanisms

5 years or less

SHORT TERM MECHANISMS OF TKA FAILURE

LITERATURE OVERVIEW

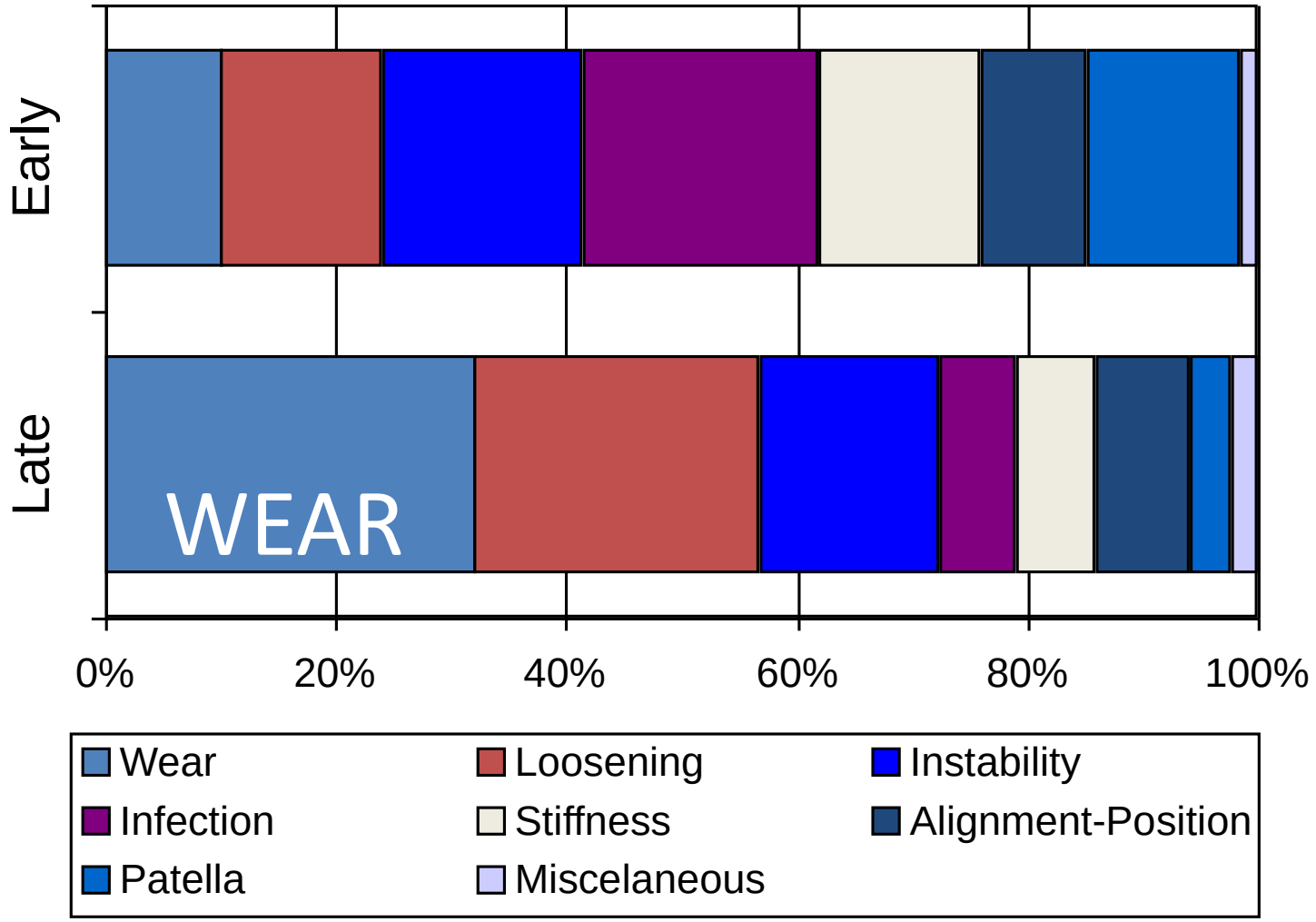
- **Fehring et al.,**[1] analyzed short-term failure mechanisms in 279 patients who required revision within 5 years of the index primary TKA. Causes of failure were infection (38%), prosthetic Instability (27%), cementless ingrowth failure (13%), patellofemoral problems (8%), and component wear and osteolysis (7%)
- **Hossain et al.,**[2] reported causes of short-term failure in their cohort of 343 patients and mean interval from primary TKA to revision of 7 years. Main causes included infection (32.7%), aseptic loosening (14.9%), and polyethylene wear (12.3%)
- **Bozic et al.,**[3] in a retrospective review of Medicare database reported infection (25.2%), mechanical loosening (16.1%), and implant failure/breakage (9.7%) as the most common causes of revision TKA

Fehring et al. CORR 2001
Hossain et al. CORR 2010
Bozic et al. CORR 2010

Why knees fail?

In the past

Sharkey et al, CORR 2002



Biomed Tech (Berl). 1998 May;43(5):151-4.

[Polyethylene in total endoprosthetics--a dead end for permanent implants?].

[Article in German]
Bädorf D, Willmann G.

1998

Historically, polyethylene wear and its sequelae (osteolysis, late instability, aseptic loosening) were common causes for revision total knee arthroplasty (TKA)

Orthopedics. 1992 Jan;15(1):23-8.

Gross polyethylene failure in total knee arthroplasty.

Heck DA[1], Clingman JK, Kettelkamp DG.

1992

POLYETHYLENE WEAR

- Less common than in the past:
    - Polyethylene manufacturing has become more consistent
    - Clearer understanding of importance of oxidation of polyethylene

D.H. Le et al.
Current Modes of Failure in TKA: Infection, Instability, and Stiffness Predominate
Clin Orthop Relat Res 2014

- Overall 7%

- Mainly occurred more than 3 years postoperatively (18.5%)

Thiele et al.
Current Failure Mechanisms After Knee Arthroplasty Have Changed: Polyethylene Wear Is Less Common in Revision Surgery
JBJS 2015

LONG TERM MECHANISMS OF TKA FAILURE

Table
Mechanism of Failure Over Time.

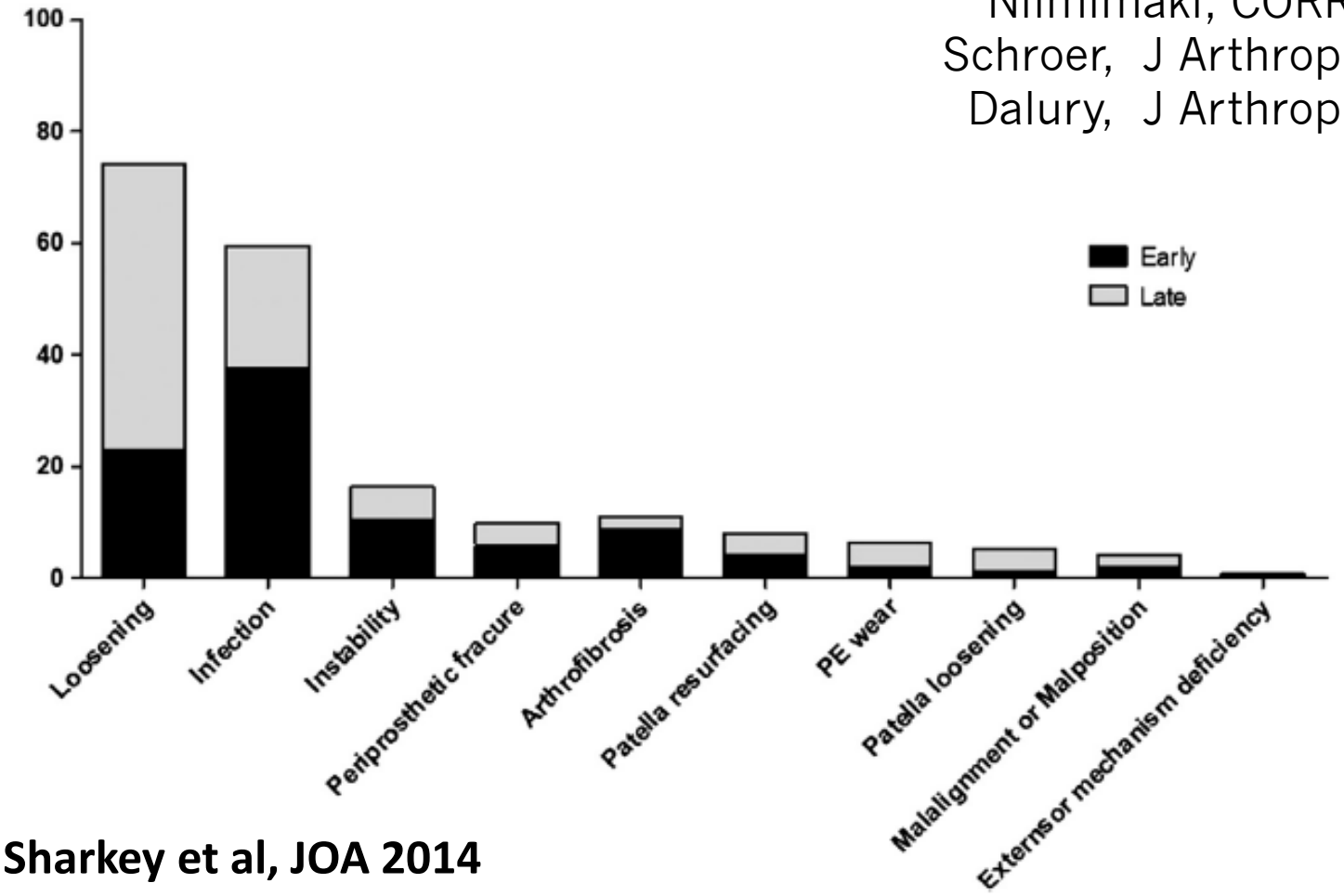
			<2 Years		2–5 Years		5–15 Years		>15 Years	
All Patients	844	100.0%	298	35.3%	210	24.9%	249	29.5%	87	10.3%
Aseptic Loosening	263	31.2%	56	18.8%	82	39.0%	99	39.8%	26	29.9%
Instability	158	18.7%	75	25.2%	39	18.6%	40	16.1%	4	4.6%
Infection	137	16.2%	68	22.8%	35	16.7%	29	11.6%	5	5.7%
Poly Wear	84	10.0%	3	1.0%	1	0.5%	38	15.3%	42	48.3%
Arthrofibrosis	59	7.0%	38	12.8%	15	7.1%	5	2.0%	1	1.1%
Malalignment	56	6.6%	24	8.1%	16	7.6%	15	6.0%	1	1.1%
Isolated Patella Revision	35	4.1%	15	5.0%	9	4.3%	8	3.2%	3	3.4%
Periprosthetic Fracture	27	3.2%	7	2.3%	5	2.4%	12	4.8%	3	3.4%
Other	13	1.5%	7	2.3%	4	1.9%	1	0.4%	1	1.1%
Extensor Mechanism	10	1.2%	5	1.7%	4	1.9%	1	0.4%	0	0.0%
AVN patella	2	0.2%	0	0.0%	0	0.0%	1	0.4%	1	1.1%

Schorer WC et al. J Arthroplasty 2011

Why knees fail?

Today

Niimimaki, CORR 2014
Schroer, J Arthropl 2013
Dalury, J Arthropl 2013



Sharkey et al, JOA 2014

…THE TIME IS CHANGED

Failure Mechanism	Total *(No. [%])* (N = 358)	Time to Revision* *(yr)*	Time to Failure† *(No. [%])*		
			Early (N = 71)	Intermediate (N = 163)	Late (N = 124)
Polyethylene wear	25 (7.0)	11 ± 3.9 (1-16)	0 (0)	2 (1.2)	23 (18.5)
Aseptic loosening	78 (21.8)	5 ± 4.5 (0-20)	9 (12.7)	26 (16.0)	43 (34.7)
Instability	78 (21.8)	3 ± 3.5 (0-19)	17 (23.9)	38 (23.3)	23 (18.5)
Periprosthetic infection	52 (14.5)	1.5 ± 3.3 (0-15)	19 (26.8)	22 (13.5)	11 (8.9)
Arthrofibrosis	16 (4.5)	1.5 ± 2.1 (0-7)	5 (7)	8 (4.9)	3 (2.4)
Malalignment	74 (20.7)	2 ± 1.7 (0-8)	13 (18.3)	48 (29.4)	13 (10.5)
Extensor mechanism deficiency	2 (0.6)	1	0 (0)	2 (1.2)	0 (0)
Periprosthetic fracture	12 (3.3)	2.5 ± 5 (0-17)	3 (4.2)	5 (3.1)	4 (3.2)
Retropatellar arthritis	21 (5.9)	2.0 ± 1.7 (0-7)	5 (7.0)	12 (7.4)	4 (3.2)

Thiele et al.
Current Failure Mechanisms After Knee Arthroplasty Have Changed: Polyethylene Wear Is Less Common in Revision Surgery
JBJS 2015

Now Loosening, infection, instability, and stiffness represent the most common causes of early and late failure

Display Settings: Abstract Send to:

Clin Orthop Relat Res. 2014 Jul;472(7):2197-200. doi: 10.1007/s11999-014-3540-y. Epub 2014 Mar 11.

Current modes of failure in TKA: infection, instability, and stiffness predominate.

Le DH[1], Goodman SB, Maloney WJ, Huddleston JI.

Author information

Display Settings: Abstract Send to:

Clin Orthop Relat Res. 2013 Jul;471(7):2296-302. doi: 10.1007/s11999-013-2940-8. Epub 2013 Mar 30.

Reason for revision TKA predicts clinical outcome: prospective evaluation of 150 consecutive patients with 2-years followup.

van Kempen RW[1], Schimmel JJ, van Hellemondt GG, Vandenneucker H, Wymenga AB.

Display Settings: Abstract Send to:

Ann Acad Med Singapore. 2013 Apr;42(4):178-83.

Revision total knee arthroplasty: causes and outcomes.

Tay KS[1], Lo NN, Yeo SJ, Chia SL, Tay DK, Chin PL.

ASEPTIC LOOSENING

ONE WORD → TWO PROCESSES

- Implants that were not well-fixed to bone from the time of surgery
- Most cases of early aseptic loosening
- Represent a failure of fixation

- Implants that were once well-fixed to the bone and loosened over time
- Most cases of late aseptic loosening (True aseptic loosening)
- Exact mechanism not completely understood, multifactorial probably
- Available literature don’t stratify reported patients on mechanism of aseptic loosening

Lombardi AV et al. BJJ 2014

ASEPTIC LOOSENING: ETIOLOGIES

- True long-term aseptic loosening is multifactorial (prosthetic malalignment, implant factors, osteolysis)
- Recent multicenter study estimated aseptic loosening to cause 40% of failures between 5 to 15 years and 30% after 15 years
- Failure of tibial component is by far more common than femoral component

Schorer WC et al. J Arthroplasty 2011

ASEPTIC LOOSENING: TIBIAL COMPONENT

- Older implants exhibited high rates of tibial component failure
  - Polycentric and geometric surface articulation
- Surface cement technique = higher loosening rate (Bert et al.)
  - Cementing the undersurface of the tibial base but not the keel
- All polyehylene tibial components: up to 30% will loosen at 10 years (Faris et al.)
- Implant design factors: Trays with shorter stems more likely to fail (Foran et al.)

Bert JM et al. AAOS Meeting 2000
Faris PM et al. JBJS 2003
Foran JRH et al. J Arthroplasty 2011

ASEPTIC LOOSENING: TIBIAL COMPONENT

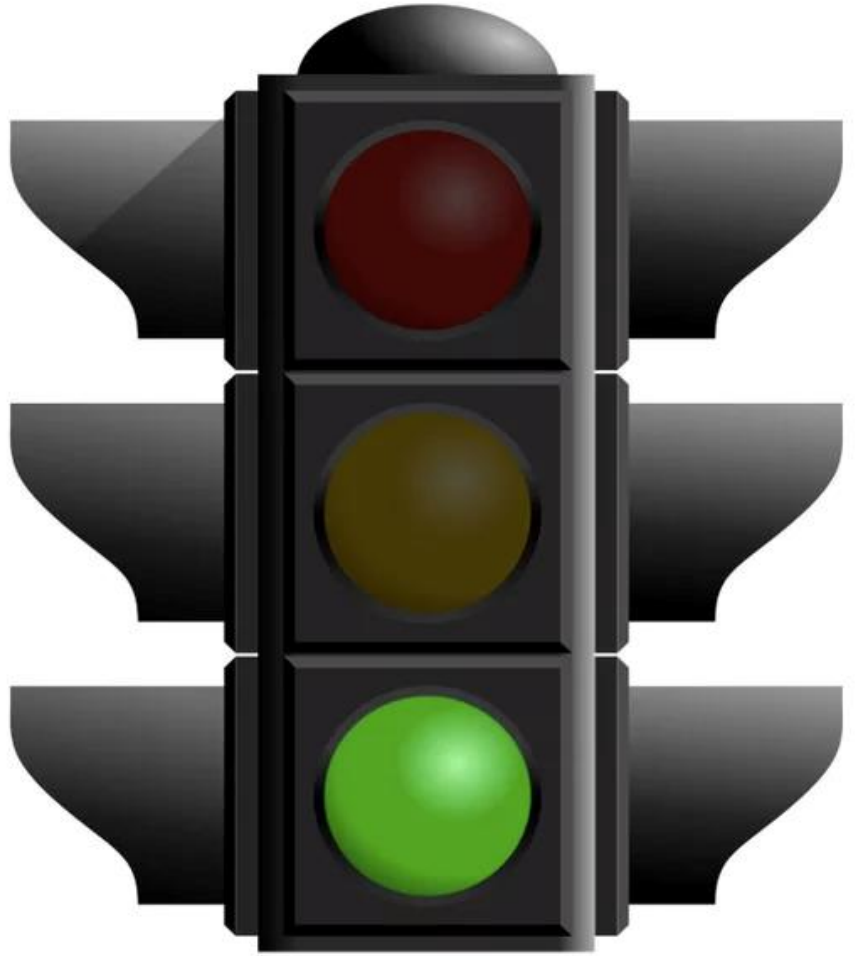
- Improved implant designs reduced tibial loosening rates:
  - Addition of central fixation pig: reduced loosening observed in various prosthesis

Wright J et alJBJS Am 1990

  - Cementing tibial stems

  - Metal backed tibial trays
    - Even distribution of stress
    - Improved long term survivorship: 97-100% at 10 to 14 years

Gioe TJ et al. COOR 2007
Parsch D et al. 2009



ASEPTIC LOOSENING: FEMORAL COMPONENT

- Uncommon when compared to tibial loosening[1]
- Estimated incidence at 1.4% at 15 years
- Unique pattern: bone resorption posteriorly causes distal femur to migrate into an anterior and flexed position
- Posterior and distal region thought to be under severe stress[2]

[1] King TV et al. CORR 1985
[2] Whiteside LA CORR 1989

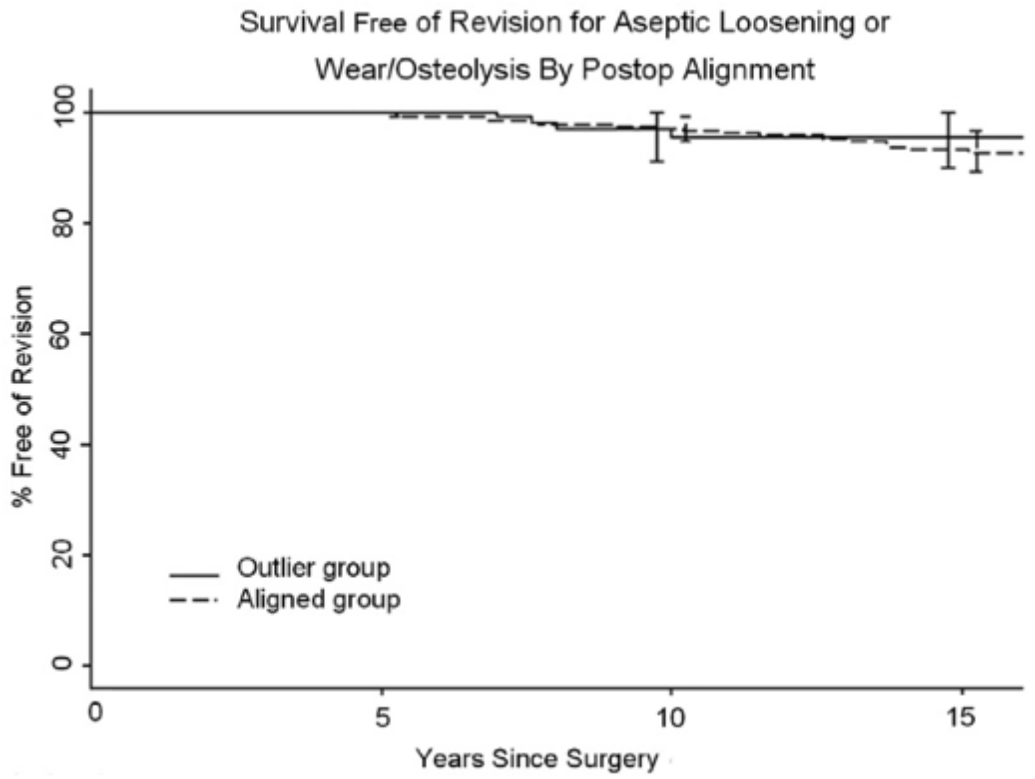
POSITIONING & LONGEVITY

398 TKAs at Mayo

Similar results at 15 yrs

for coronal alignment

within 0±3° or outliers



Parratte-Pagnano, JBJS-A 2010

POSITIONING & LONGEVITY

International Orthopaedics (SICOT) (2014) 38:379–385
DOI 10.1007/s00264-013-2097-9

ORIGINAL PAPER

The relationship between the survival of total knee arthroplasty and postoperative coronal, sagittal and rotational alignment of knee prosthesis

Young-Hoo Kim · Jang-Won Park · Jun-Shik Kim · Sang-Doo Park

3048 TKAs prospectively followed for 16 years

(80% Stat power fo malalign/hazard risk of failure: need 2000TKAs)

POSITIONING & LONGEVITY

Single surgeon, technique, implant

HKA > 4° Varus

Coronal femur < 2.0° VL

Flexion femur >3°

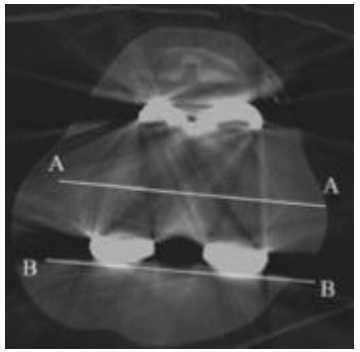
Coronal tibia < 90°

Sagittal tibia <0° or >7°

Int. Rot. femur or tibia

Worse outcome
for outliers

CT + Long-films in all!



Kim, Int Orthop, 2014

PERIPROSTHETIC INFECTION

- Infection is less likely a cause of failure beyond two years
- Most studies reported on infection as the leading cause of failure in the first two years from the index surgery
- Some authors reported on septic failure at between 2 to 5 years
- At 10 to 15 years, it is very rarely reported failure mechanism. However, probably under-reported

Sharkey et al. Clin Ortho 2002
Lombardi et al. BJJ 2014

LABORATORY ASSESSMENT

Studies include:

- Erythrocyte sedimentation rate
- C-reactive protein
- Aspirate

Should be obtained in all patients presenting with pain or failure following TKA as a screen for periprosthetic joint infection

J Parvizi et al 2011, Clin. Orthop Rel Research

WHY KNEES FAIL?

TODAY

- ✓ Aseptic loosening (31,2 %)
- ✓ **Instability** (18,7 %)
- ✓ Infection (16,2 %)
- ✓ Polyethylene wear (10 %)
- ✓ Arthrofibrosis (6,9 %)
- ✓ Malalignment (6,6 %)

Bone Joint J. 2014 Nov;96-B(11 Supple A):101-4. doi: 10.1302/0301-620X.96B11.34350.

Why knee replacements fail in 2013: patient, surgeon, or implant?

Lombardi AV Jr[1], Berend KR[1], Adams JB[1].

JB&JS

THE JOURNAL OF BONE & JOINT SURGERY

INSTABILITY AFTER TKA

Tibiofemoral instability can be classified into 3 different patterns:

- Extension instability
- Flexion instability
- (Midflexion Instability)
- Genu recurvatum

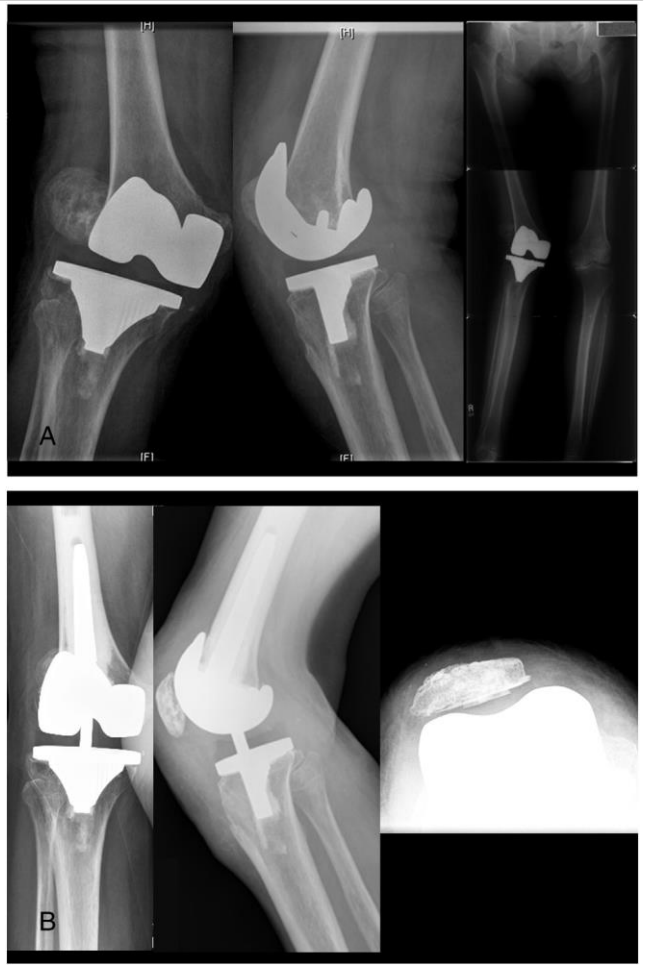
Instability after total knee arthroplasty.

Parratte S[1], Pagnano MW.

2008

ETIOLOGY

- Flexion/extension gap mismatch
- Component malposition
- Isolated ligament insufficiency
- Extensor mechanism insufficiency
- Component loosening
- Global instability



Jun Song et al 2013, Journal of Arthroplasty

INSTABILITY

- Less common cause of long-term failure
- Responsible for 16% of revisions at 5 to 15 years, which drops to 4.6% after 15 years
- Vince et al., (2006) reported on progressive late instability to be multifactorial:
  - Repetitive injury from excessive stress on collateral ligaments in obese patient
  - Progressive ligaments loosening with excessive activity

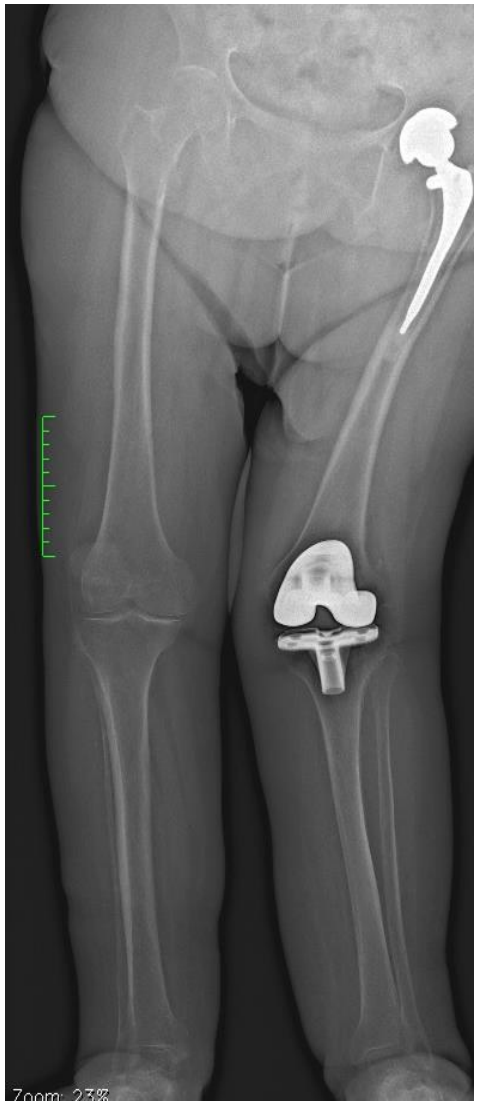
Vince KG et al. J Arthroplasty 2006

LATE INSTABILITY

- Mulhall et al. (2006) reported instability as one of the predominant causes in their cohort with mean time to revision of 8 years from index procedure, possible linked risk factors:
  - Secondary to PE wear in 44% of instability cases
  - Implant loosening/ migration in 29%
  - Or : late ligamentous failure

- Overall: on the long-term seems to be a secondary mechanism for failure following aseptic loosening or poly wear

Mulhall KJ et al. CORR 2006



MIDFLEXION INSTABILITY

Increased laxity at midrange of flexion *despite appropriate tension at full extension and 90 degrees of flexion*

The Influence of Joint Line Position on Knee Stability After Condylar Knee Arthroplasty

JEFFREY W. MARTIN, M.D., AND LEO A. WHITESIDE, M.D. 1990

CLINICAL PRESENTATION

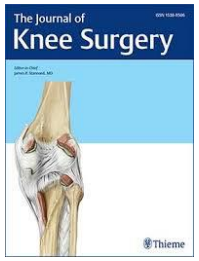
No true diagnostic criteria for MFI exist

- **Non specific findings**:
  - recurrent **effusions**
  - sense of knee **instability** without it giving way (expecially in **stand-to-sit** position, during **stair climbing**)
  - soft tissue **tenderness** to palpation.

Midflexion Instability in Primary Total Knee Arthroplasty: A Review Article

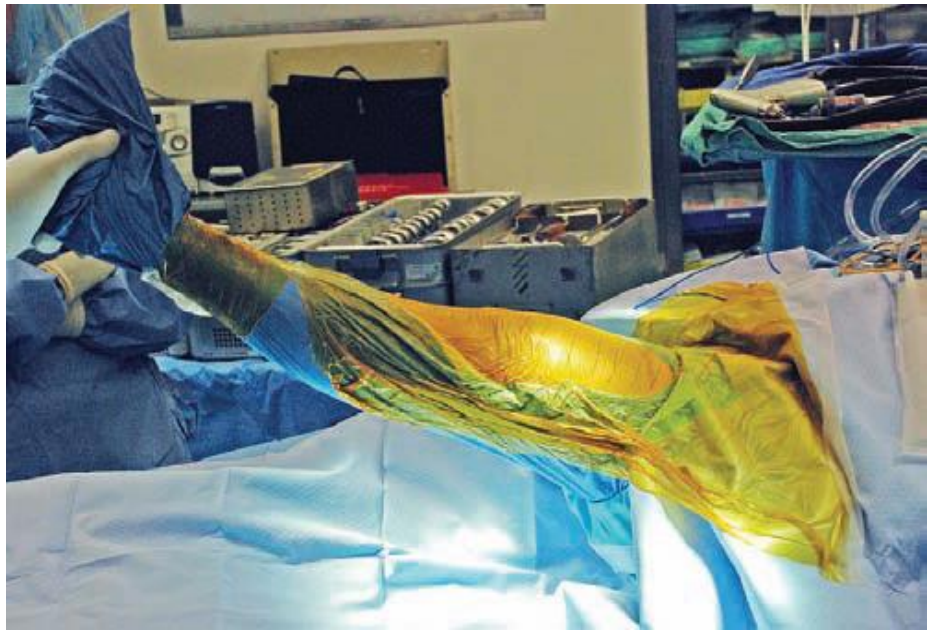
Matthew Nagle, MB, MSc, MRCSI[1] Aaron Glynn, MB, MCh, FRCSI[2]

2019



Stiffness after TKA

- Frustating problem for both patient and surgeon
- Few patients with substantial limitation of ROM are satisfied with their results
- Prevalence: 1.5-12%



A Contemporary Approach

- EXTRINSIC CAUSES

Outside of the knee: hip and spine problems

- INTRINSIC CAUSES

Within the knee itself: infection, loosening or failed ingrowth, surgical technique issues, implant issues

- PATIENT-SPECIFIC CAUSES

Abnormal inflammatory response, patient motivation, genetics

The stiff total knee Arthroplasty: A contemporary approach

Pagnano et al.

Results of Revision TKA for “Unexplained Stiffness”

- **Modest gains in ROM and fucnction**
- **17 – 30 degree improvment in arc of motion**
- **Most Knees still can not flex > 90 degrees**

- Kim et al JBJS, 2004
- Mont et al CORR, 2006
- Keeney et al CORR, 2005
- Ries et al CORR, 2000
- Williams et al CORR, 1996
- Haidukewych et al J Arthroplasty, 2005
- Christenson et al J Arthroplasty, 2002

OSTEOLYSIS

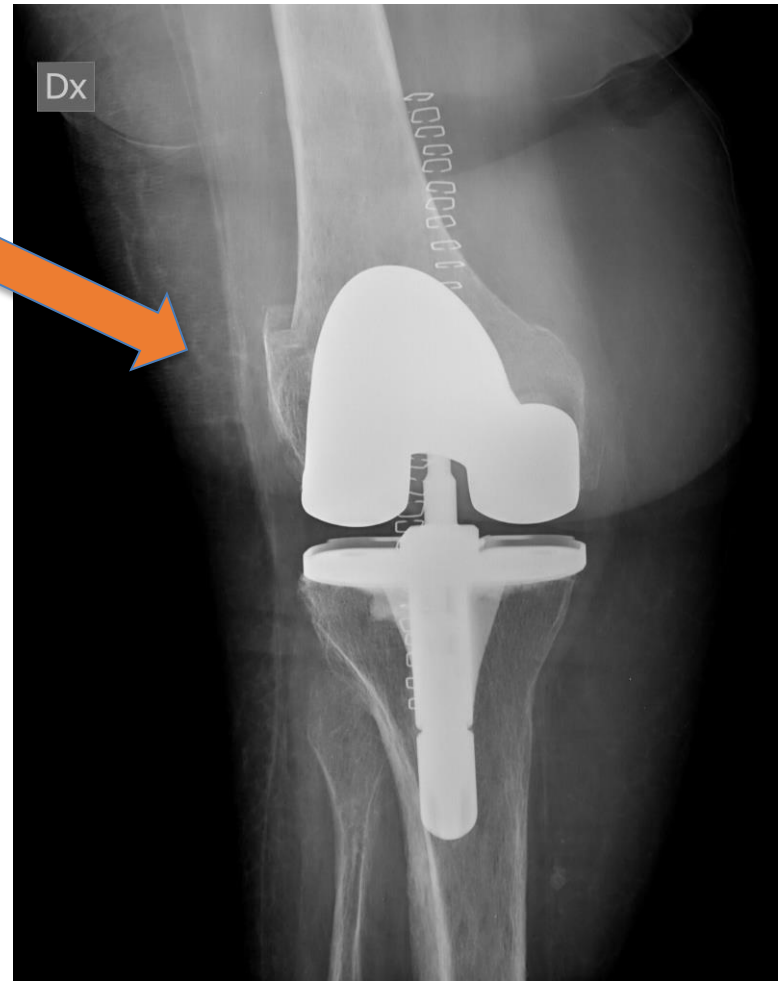
- Inflammatory response to particulate debris
- Reported at 7% between, 10 to 18 years post-implantation[1]

- Linked to certain factors :
  - Polyethylene (PE) sterilization method: reduced osteolysis with PE-sterilized in inert gas (vs. air) and non-radiation methods[2]
  - The use of PS knees: associated tibial post impingement
  - Backside wear in modular designs, and backside wear in mobile-bearing knees[3]
  - Younger age is associated with radiographic evidence of osteolysis, but no demonstrated clinical relevance[1]

[1] Lachiewicz PF et al. JBJS Am 2004
[2] Collier MB JBJS Am 2007
[3] Collier MB JBJS Am 2005

PERIPROSTHETIC FRACTURES

- Long-term data on the incidence of periprosthetic fractures (after 10 years) is lacking
- Vessely et al. reported on incidence of peri-prosthetic fractures in a large cohort of 1,000 patients followed for mean of 15.7 years
- Overall, they reported periprosthetic fractures prevalence rates of femoral (1.4%) and patellar (2.0%) periprosthetic fractures.
- This may reflect a rising problem with improved implant survivorship in an aging population



Vessely MB et al. CORR 2006

AND…

"Unexplained" pain

Metal hypersensitivity ?

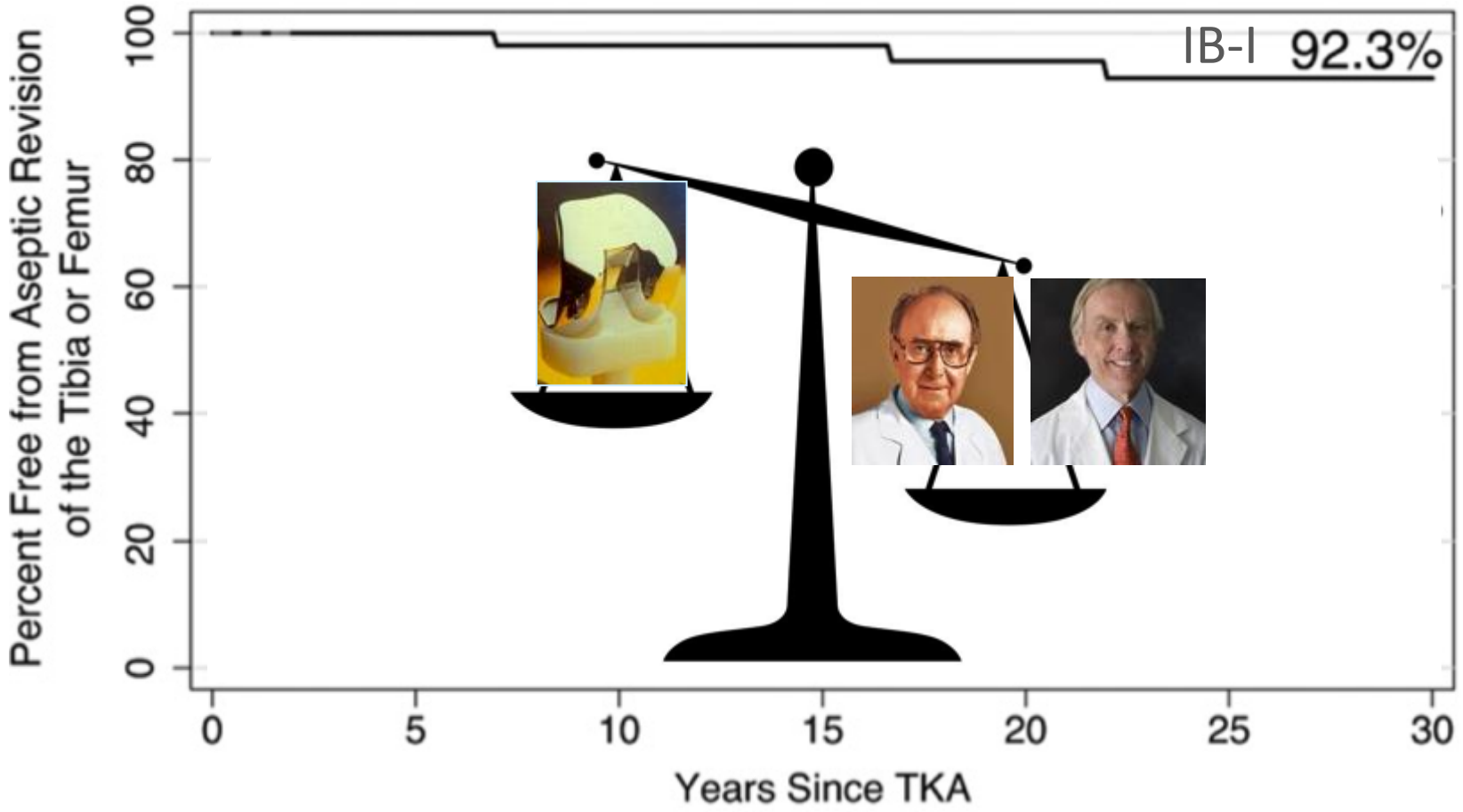
JACOBS, JBJS-A 2001

"Myths"

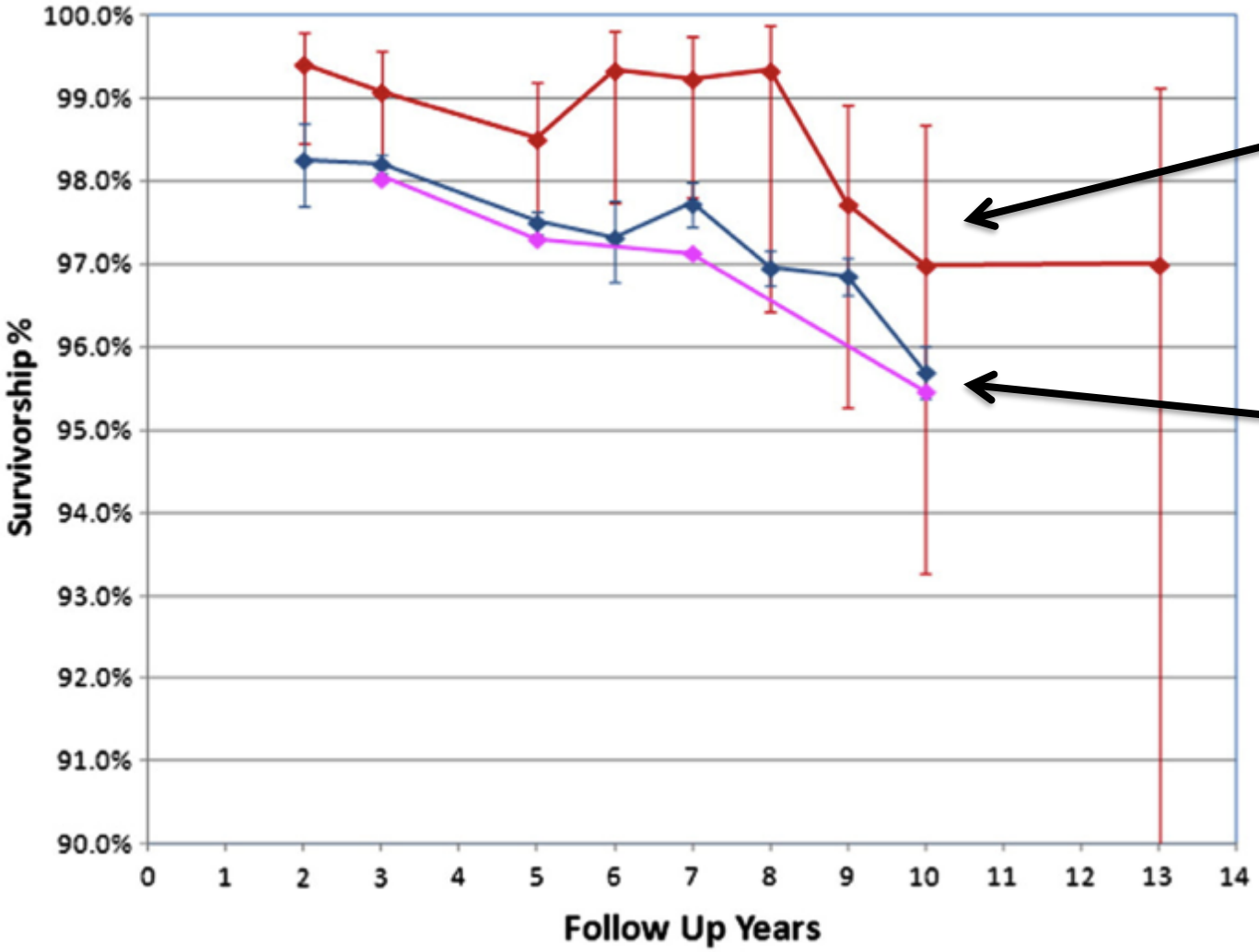
1. «Components are too big»…
2. Impression of malrotation on xrays
3. Neuromas around the knee
4. Tight PCL
5. Soft tissue entrapment
6. Most of the suspected allergies

THE X-FACTOR

Surgeon factor



Registry vs single series



Single surgeon series

Registry data

Hopley-Dalury J Arthropl, 2014

The Surgeon's Role in Relative Success of PCL-Retaining and PCL-Substituting Total Knee Arthroplasty

Merrill A. Ritter, MD · Kenneth E. Davis, MS · Alex Farris, BA · E. Michael Keating, MD · Philip M. Faris, MD

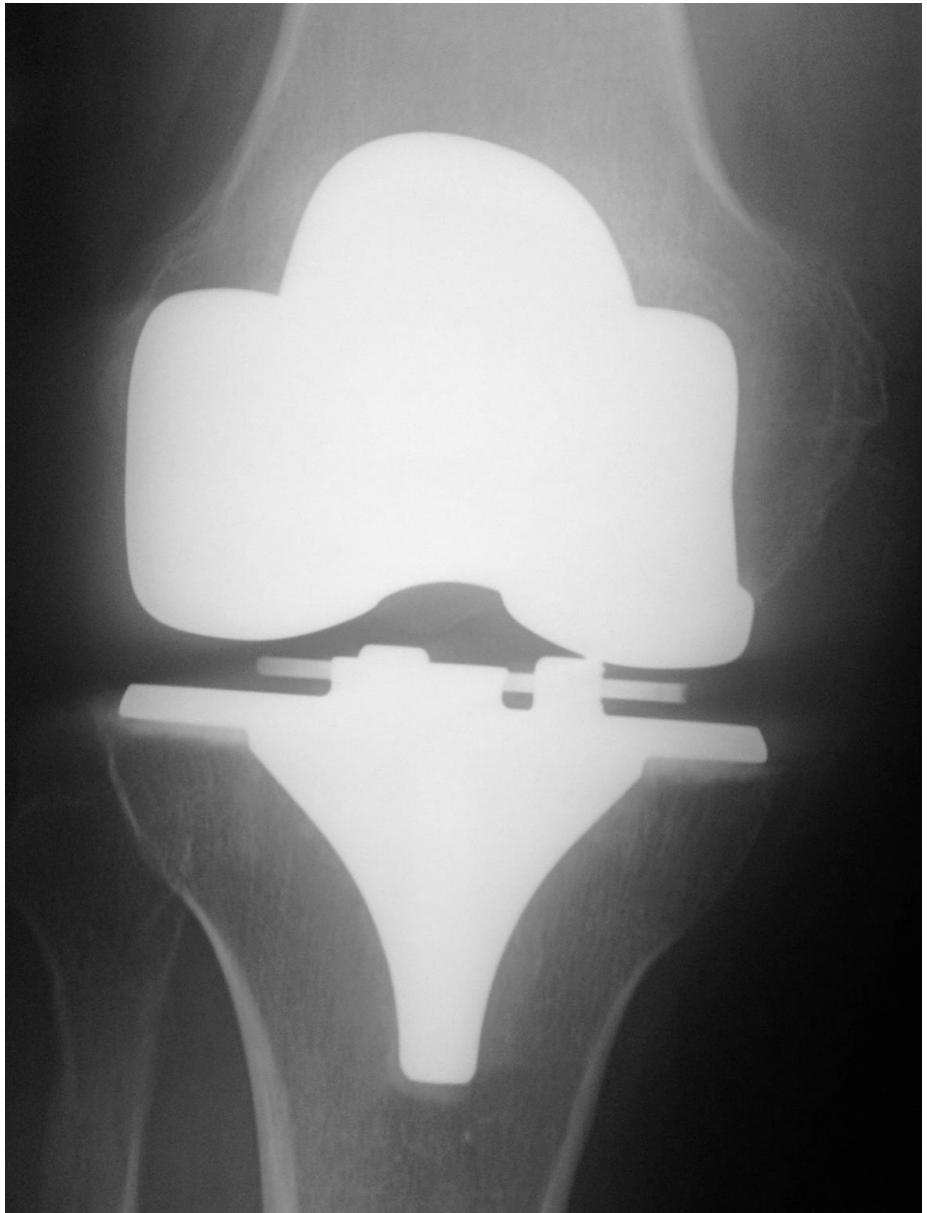
8604 TKAs

4 implants

6 surgeons

"The operating surgeon may prove to be a substantially influential variable of overall TKA success than previously thought."

WRONG INDICATION



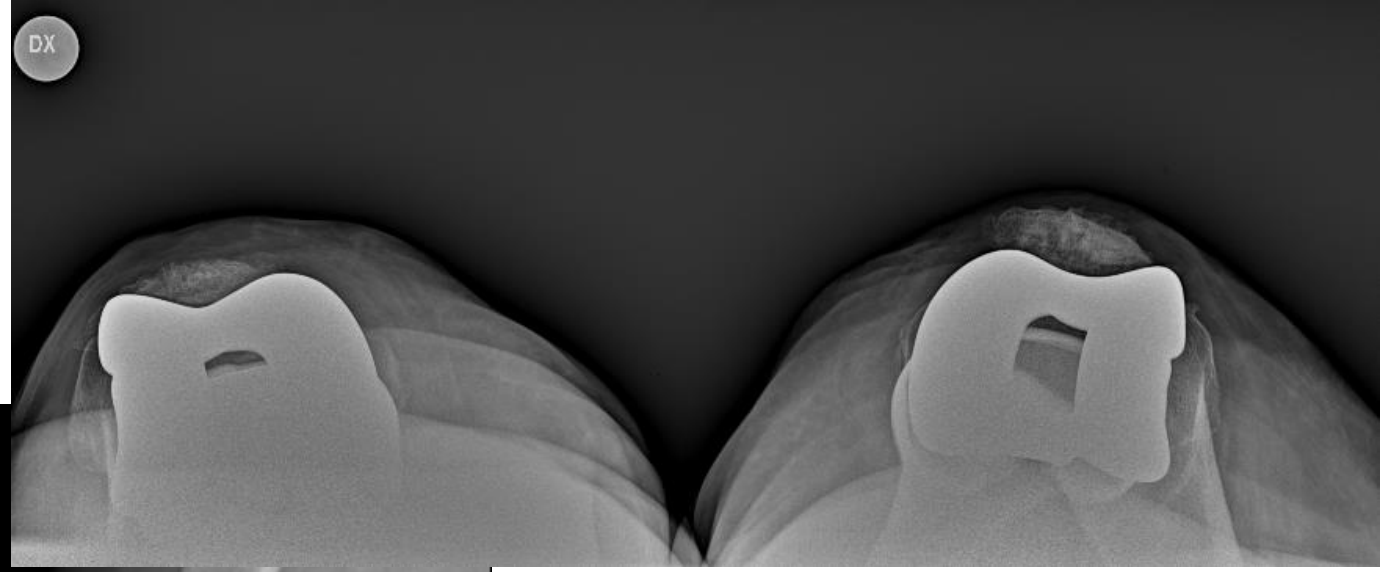
Patient selection

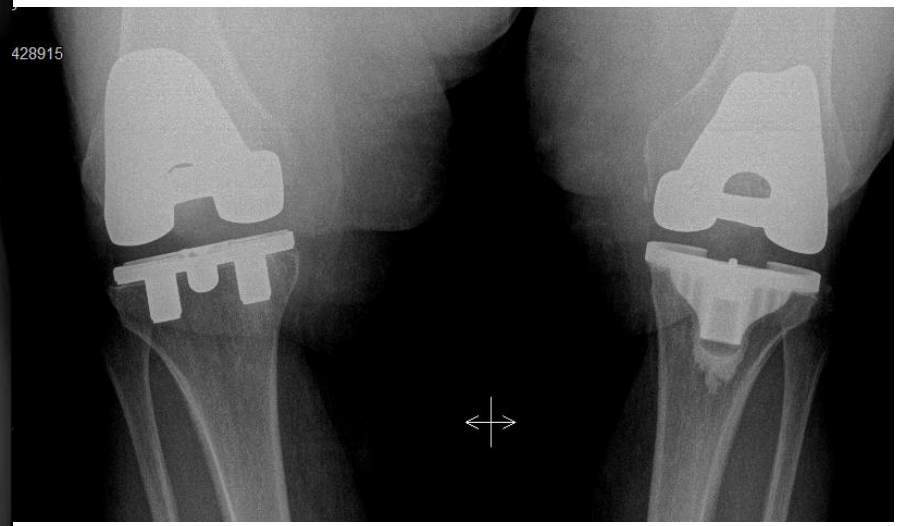
"Good looking" painful TKA

Always ask for preop x-rays

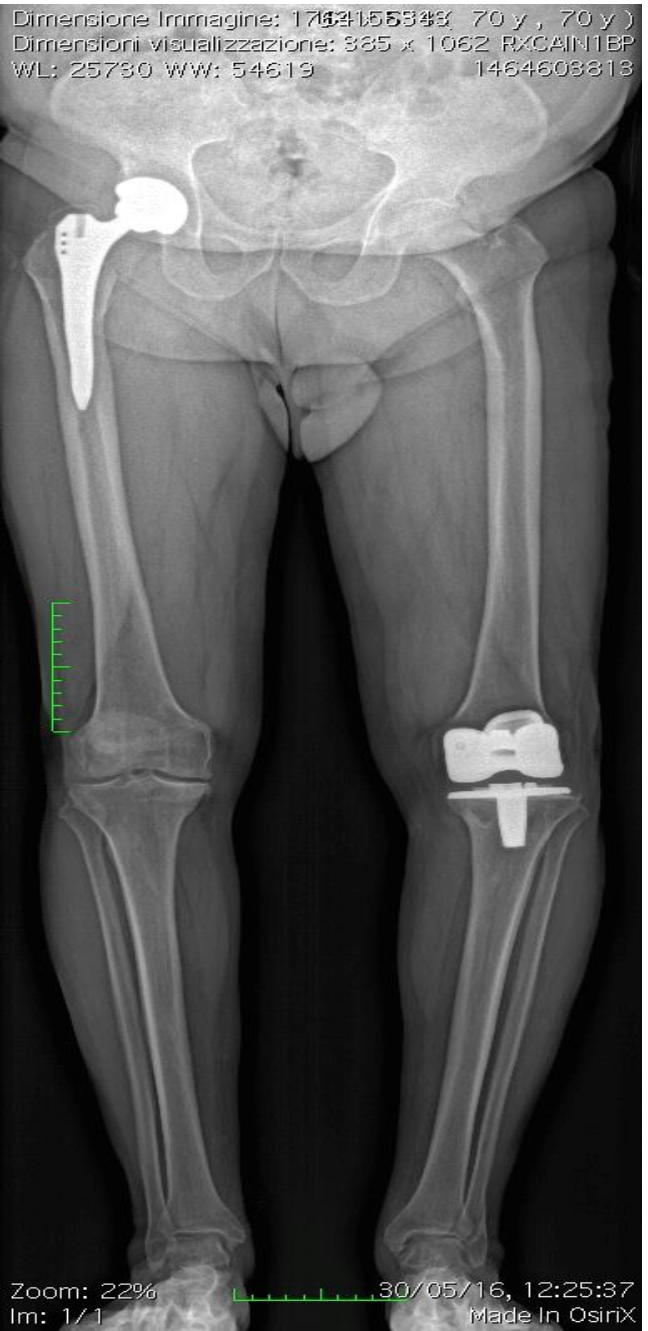
THANK YOU

Templari M Luigia (esiti PTG dx piatto TMT)
Rev con LCCK, coni, augment , fresa ad alta velocita’

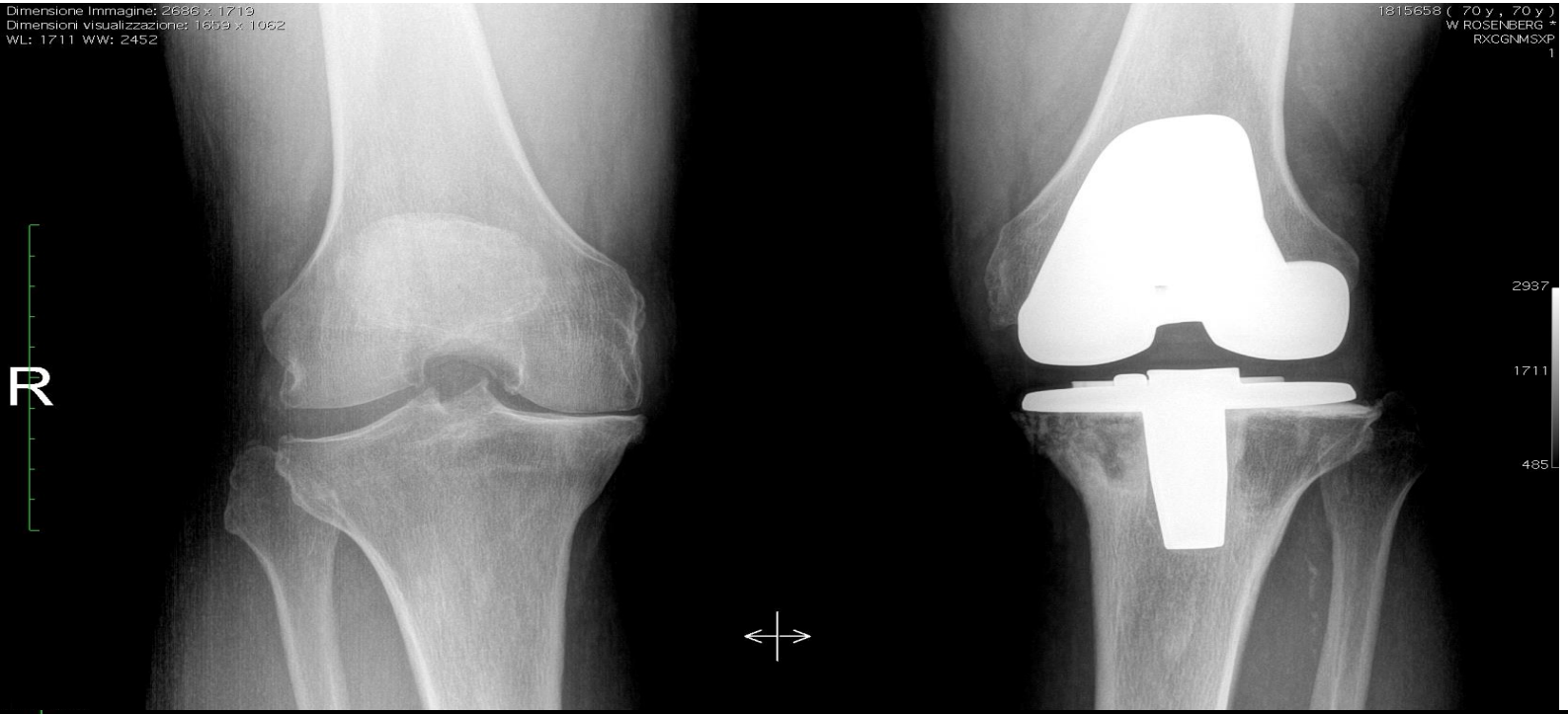


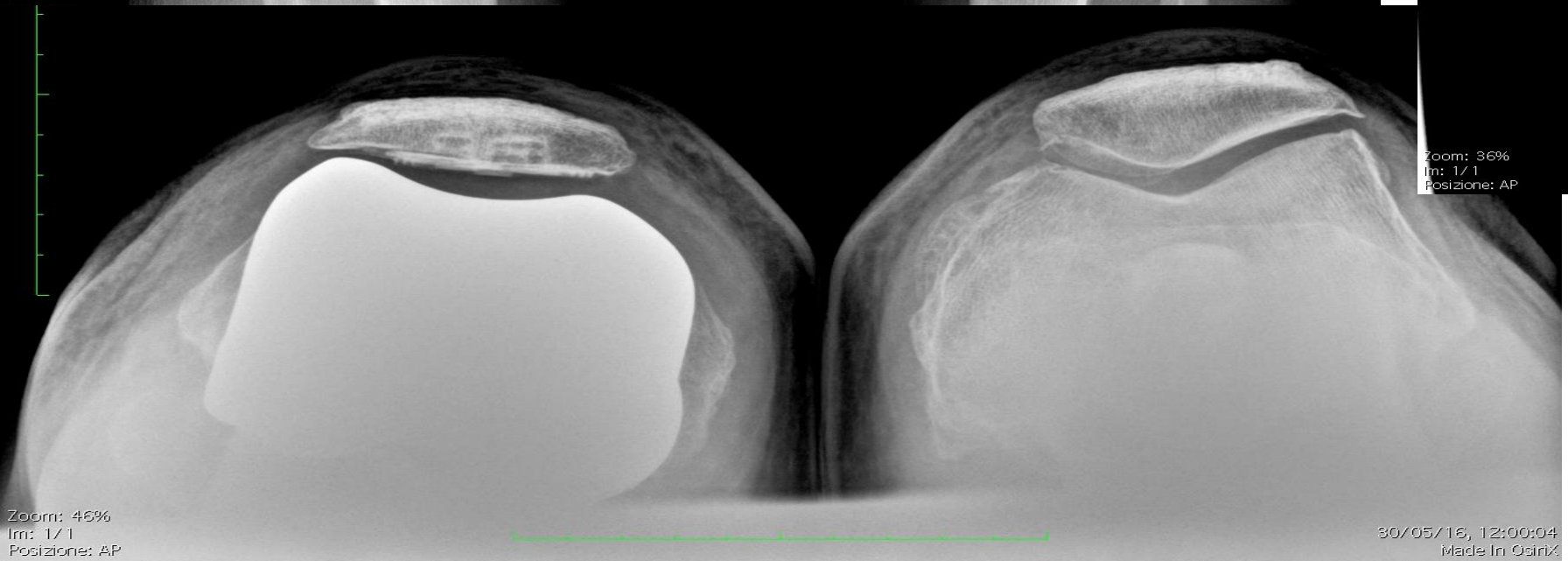


Sig. Zermani Daniele 70 yrs mobilizz PTG sx indicata LCCK / Vanguard 360

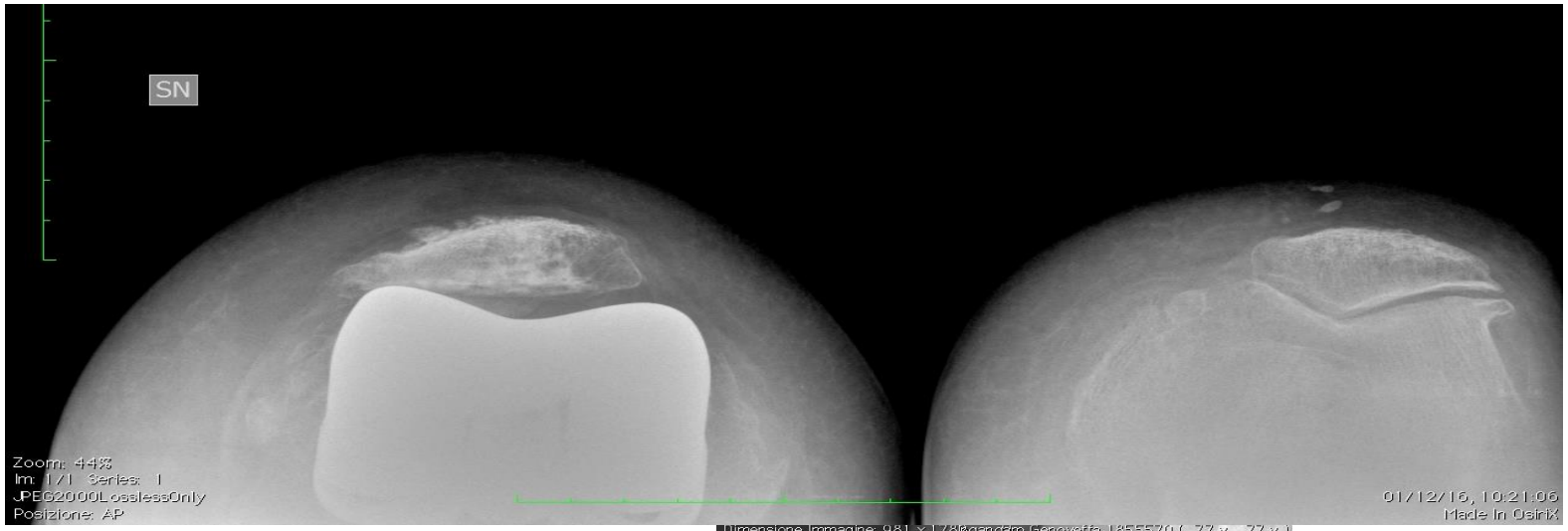


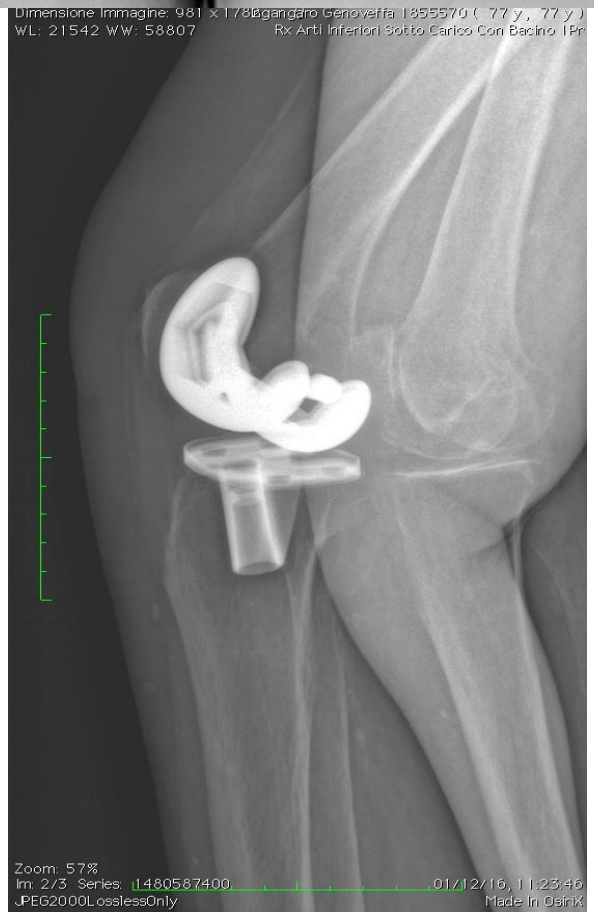
Sig. Zermani Daniele 70 yrs mobilizz PTG sx indicata LCCK / Vanguard 360





INGANGARO GENOVEFFA 77 YRS
INSTABILITA'-MOBILIZZAZIONE
RHK





POSITIONING & LONGEVITY

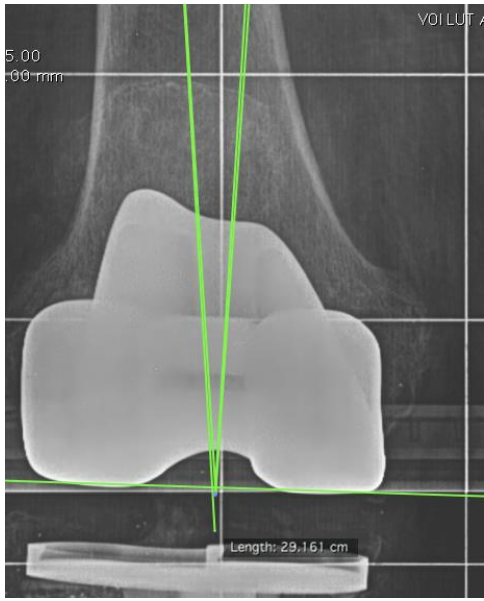
Clin Orthop Relat Res. 2004 Nov;(428):26-34.

Tibial component failure mechanisms in total knee arthroplasty.

Berend ME[1], Ritter MA, Meding JB, Faris PM, Keating EM, Redelman R, Faris GW, Davis KE.

- Tibial component alignment (p<0.007)
  - failed: 3.2° varus
  - survived: 0.2° varus
- Overall alignment
  - failed: 1.6° valgus
  - overall: 3.9° valgus

«Varus component alignment has been reporte to increase aseptic tibial component alignment through medial tibial collapse»



INSTABILITY PATTERNS

Tibiofemoral instability can be classified into 3 different patterns:

- Flexion instability
- (Mid flexion instability??)
- Genu recurvatum
- Extension instability

Paratte and Pagnano 2008, Instructional Course Lecture, AAOS
Cottino, Sculco et al 2016, Journal of Arthroplasty

Patient selection

Exclude other sources of pain

No surgery without a cause