

...Toward customized TKA...

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Centre Orthopédique Santy Lyon

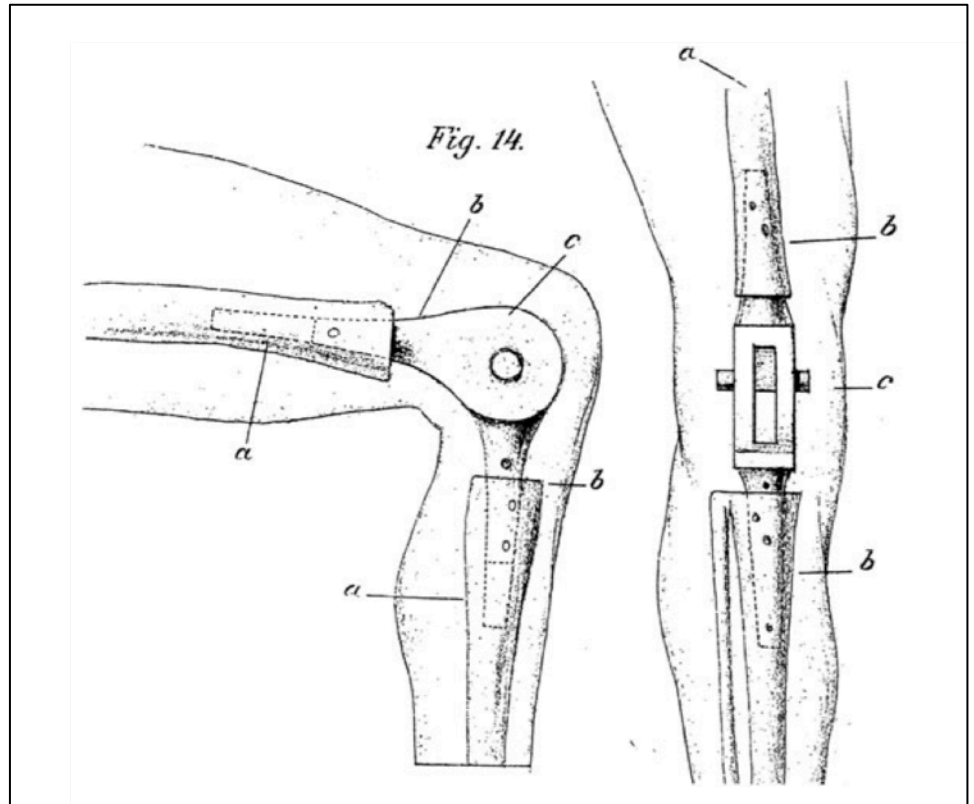
1

...What is a TKA? ...

The first 'artificial knee' implanted in May 1890



Themistocles Gluck



1900-1950 knee arthroplasty ~ resurfacing



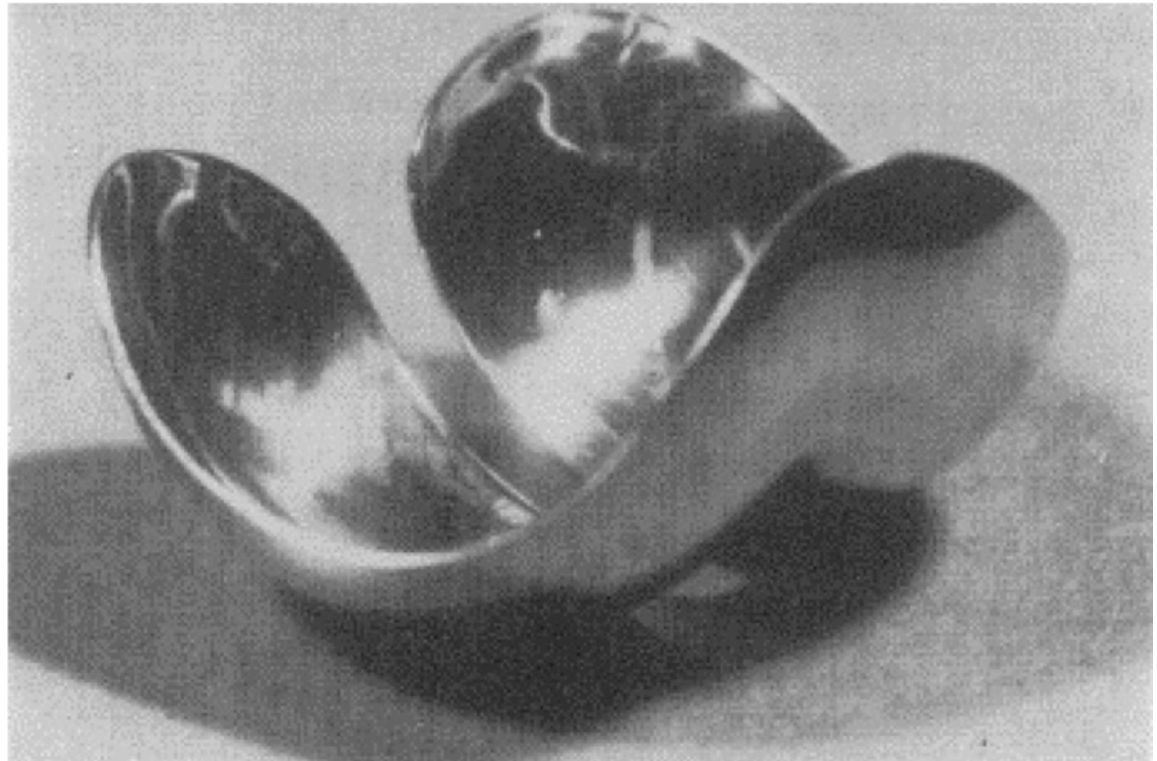
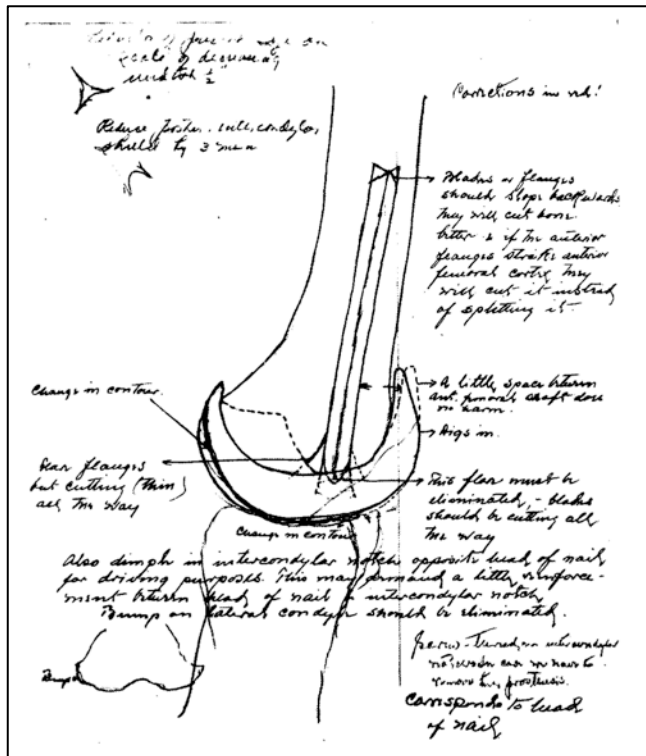
*Campbell's operative orthopaedics.
Mosby Company, 1963, p 1081*



Campbell W (1940) Am J Surg 47 (3):639-641.

1940's Customized implants

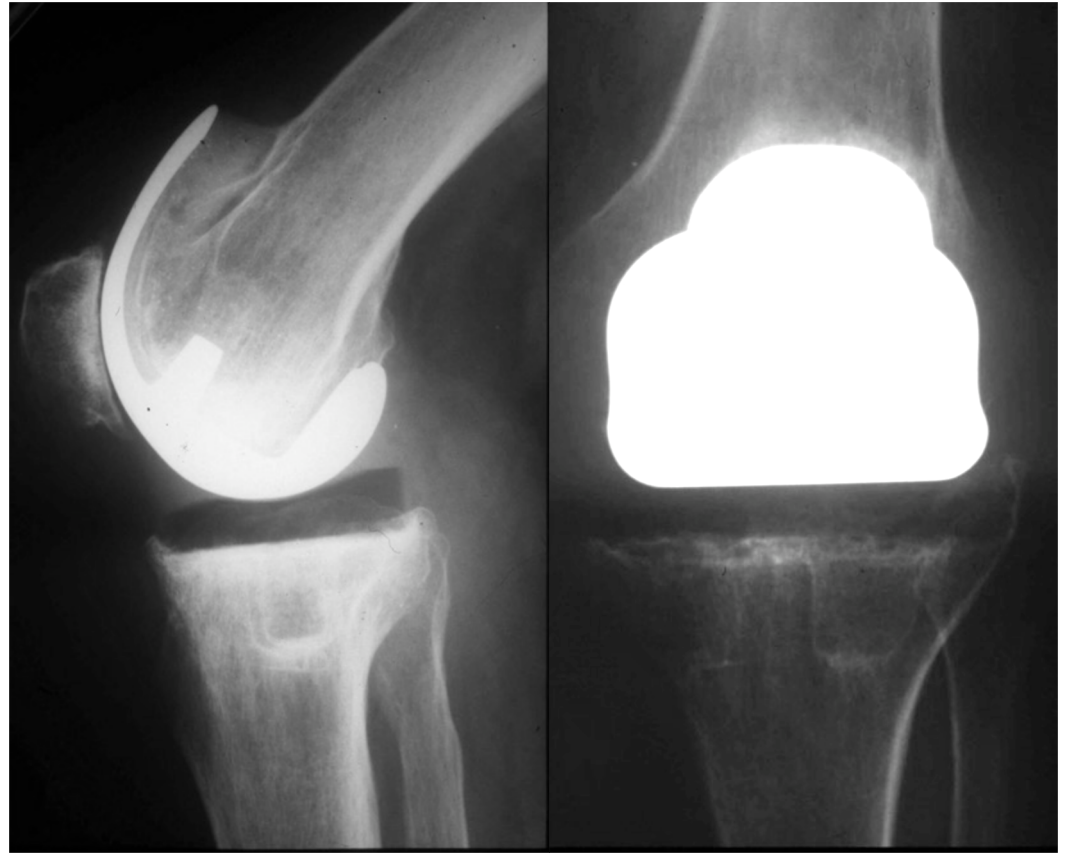
The Smith Petersen mould arthroplasty.



From Jones WN (1969) Mold arthroplasty of the knee joint. CORR 66:82-89

1970s':

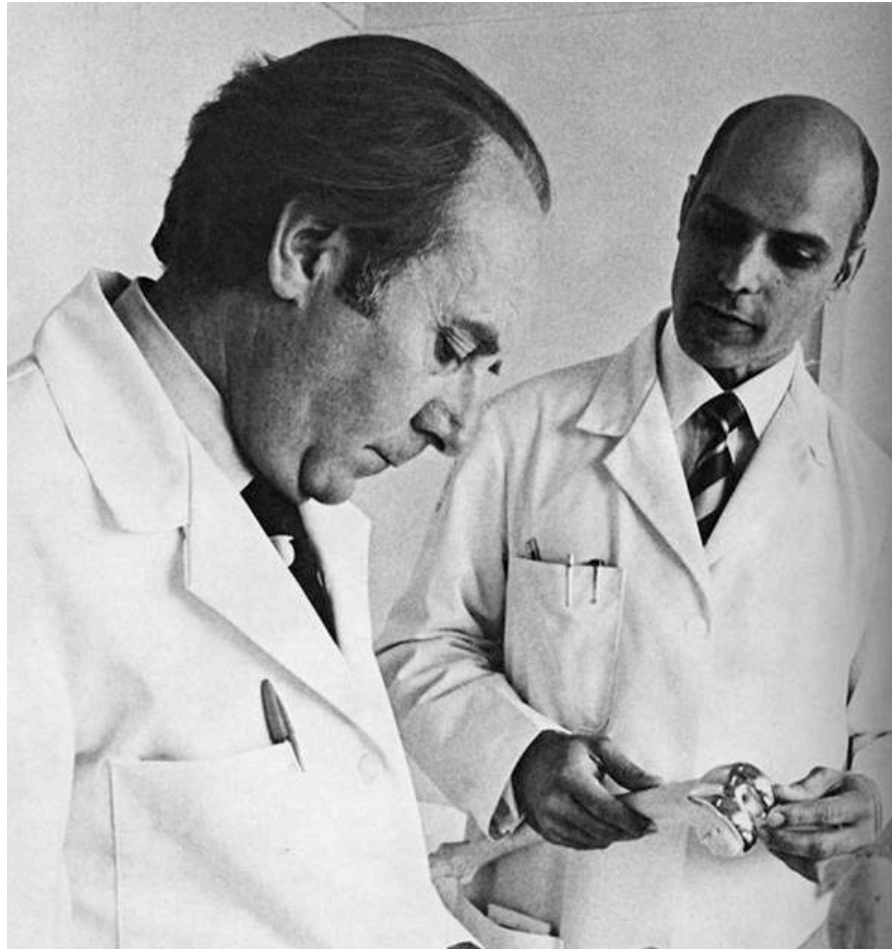
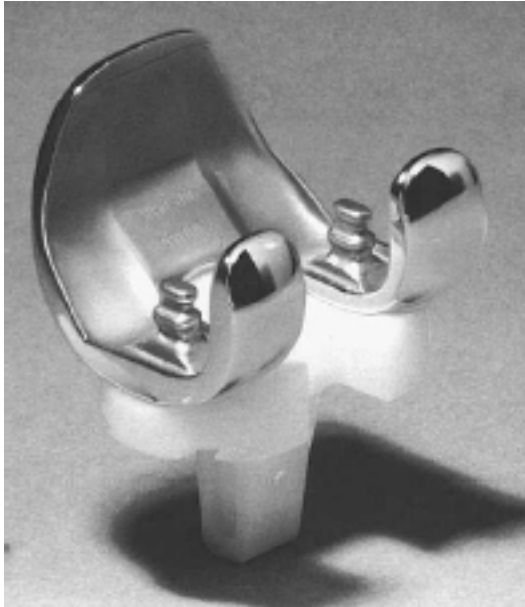
Modern TKA



Mickael Freeman: Imperial College 1970

1970s':

Modern TKA



J. Insall & C. Ranawat: New York 1973

👉 TKA is now a 'mass product'

— Instrumentation

— Biomaterials



Chitranjan S. Ranawat, MD



John Insall, MD



Thomas Sculco, MD



David S. Hungerford, MD



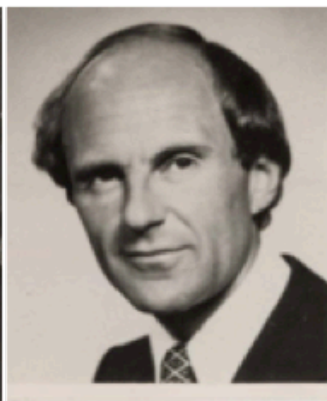
Paul A. Lotke, MD



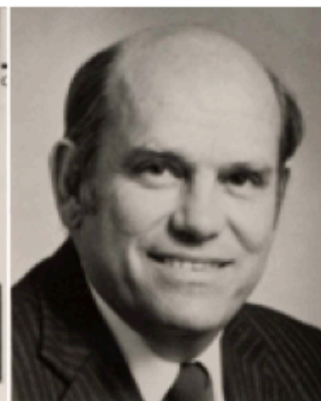
James Rand, MD



Donald Kettelkamp, MD



S. David Stulberg, MD



Lawrence Dorr, MD



Leonard Marmour, MD

TKA is not anymore a 'resurfacing'

- Sizing
- Kinematics
- Rotation
- Alignment
- Patello-femoral



2

... Sizing ...

1970-1980:

Only one size for Total Condylar!

Copyright 1983 by *The Journal of Bone and Joint Surgery, Incorporated*

The Total Condylar Knee Prosthesis in Gonarthrosis

A FIVE TO NINE-YEAR FOLLOW-UP OF THE FIRST
ONE HUNDRED CONSECUTIVE REPLACEMENTS

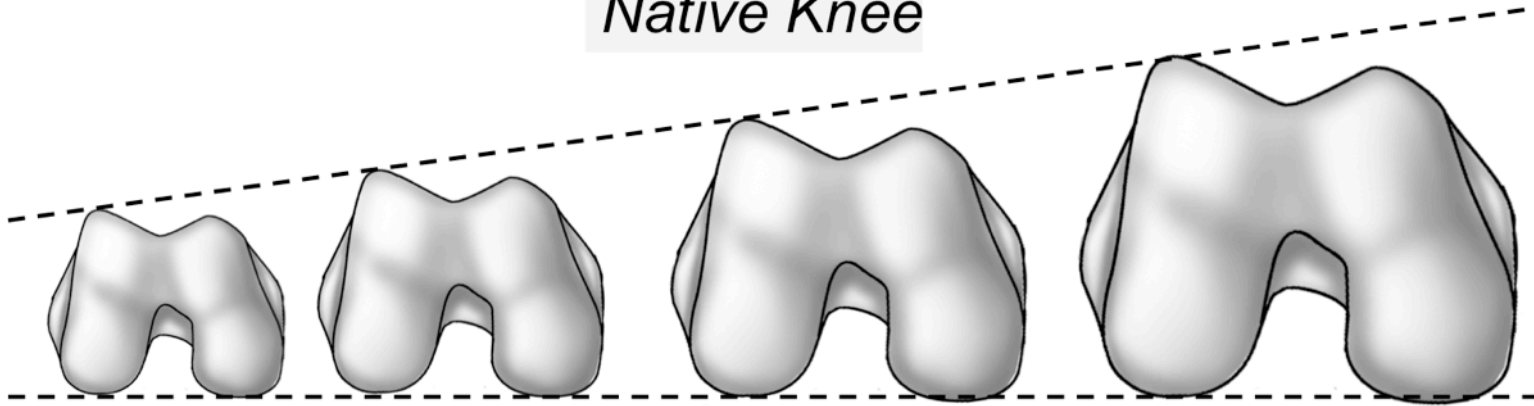
BY JOHN N. INSALL, M.D.* , ROGER W. HOOD, M.D.† , LAURA B. FLAWN, M.D.* , AND
DENNIS J. SULLIVAN, M.D.* , NEW YORK, N.Y.

*From The Hospital for Special Surgery, Affiliated with The New York
Hospital-Cornell University Medical College, New York City*

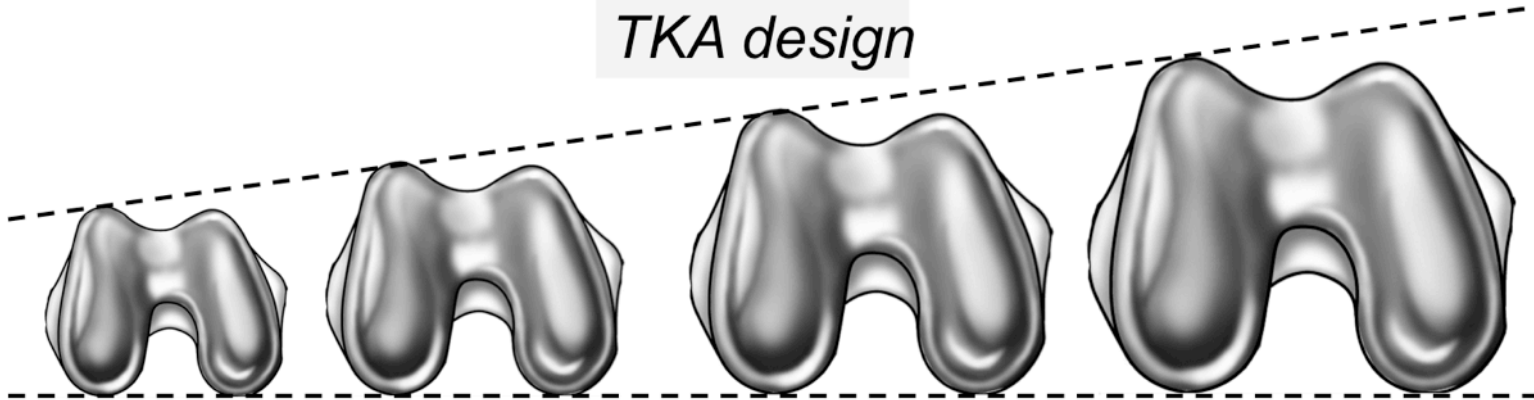
1980-2000:

Proportional evolution

Native Knee



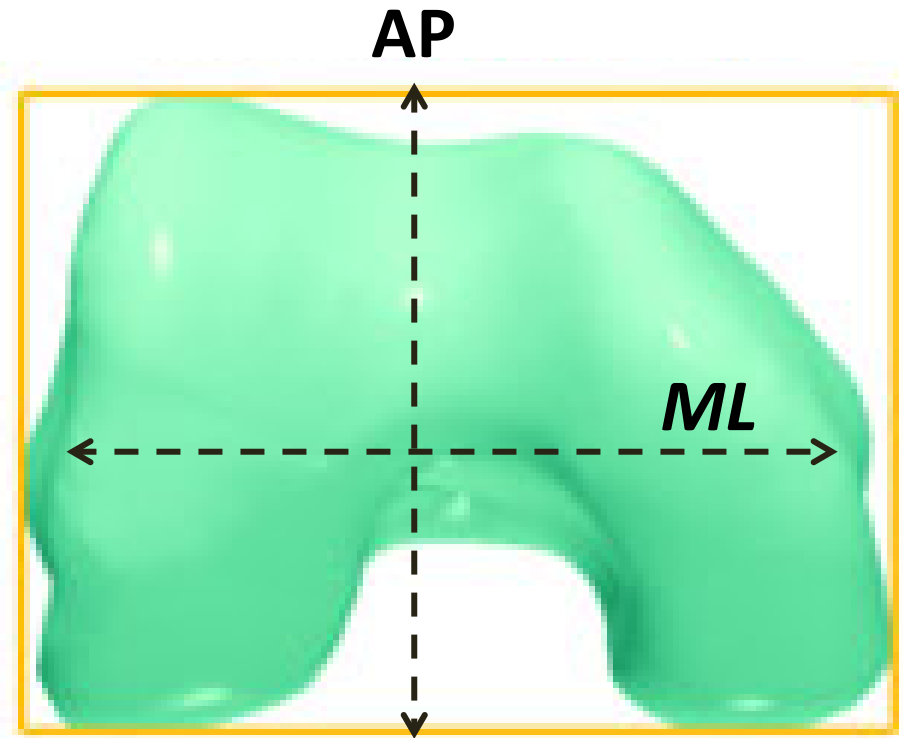
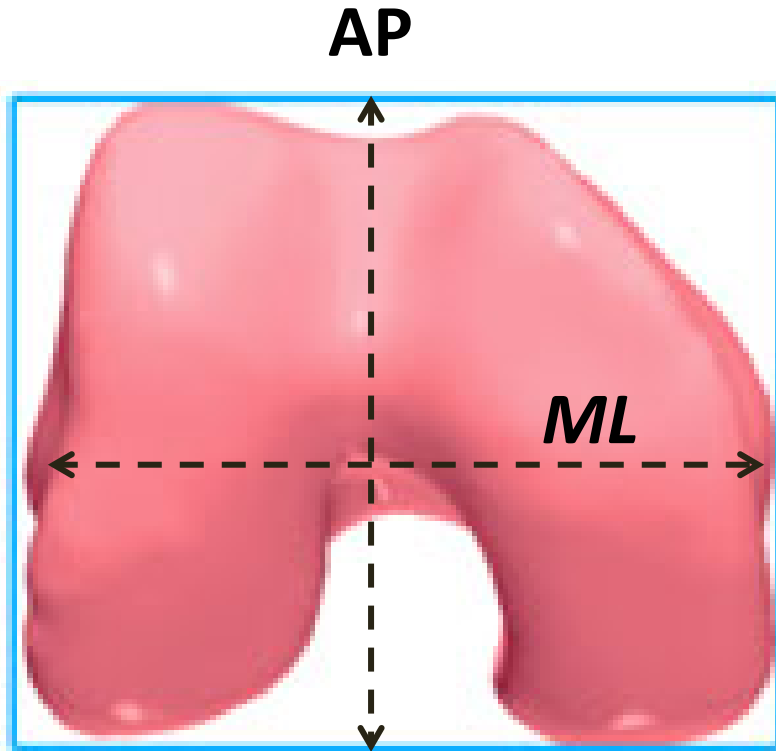
TKA design



2003:

Variations of shape

Hitt Jbjs (Am) 2003

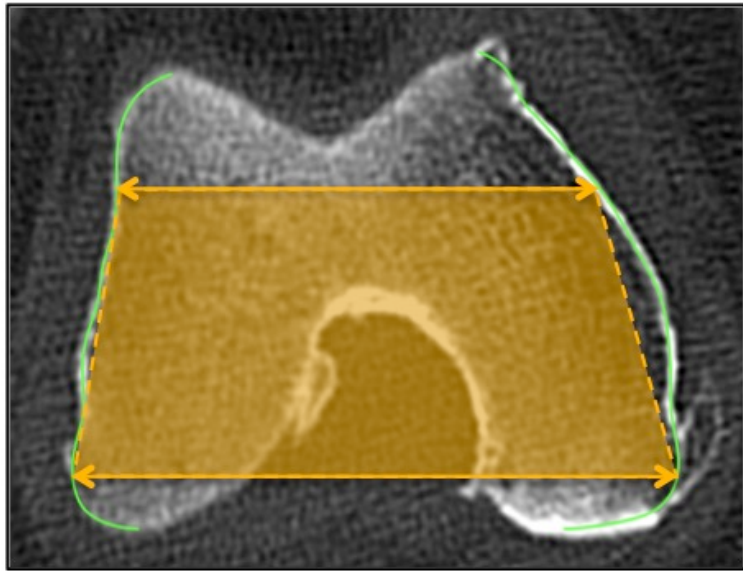


Narrow implants

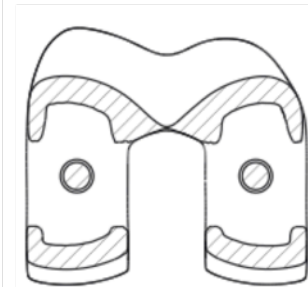
2016:

Trapezoidicity ratio

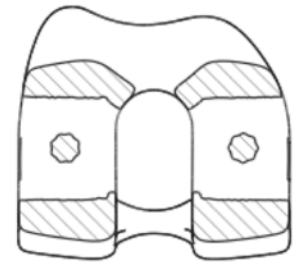
Bonnin et al BJJ 2016



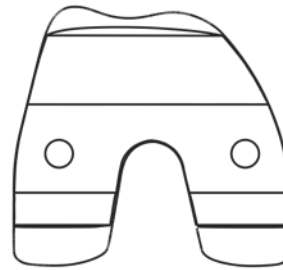
Tornier Noetos



DePuy LCS



Biomet Vanguard



Zimmer Persona



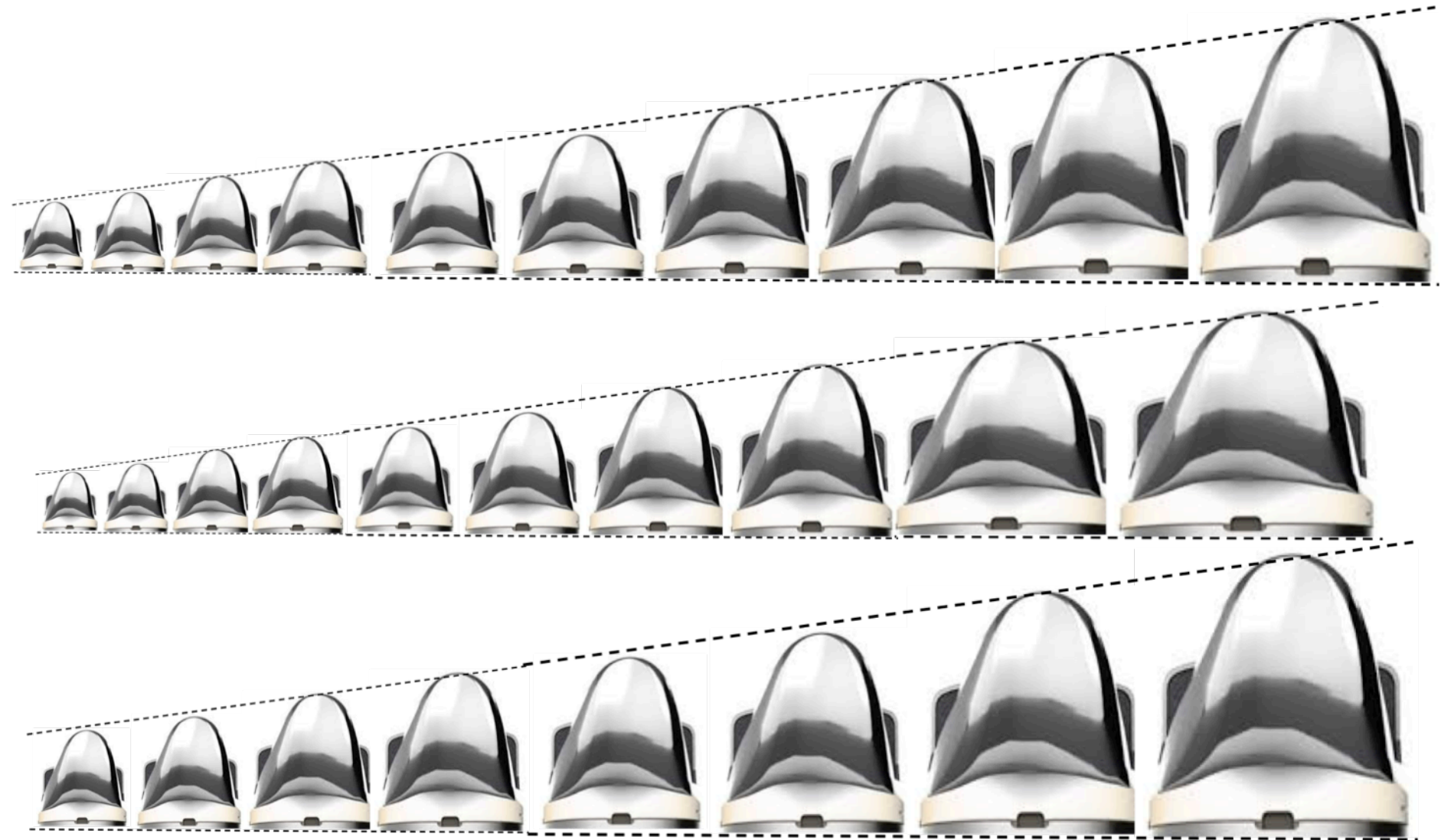
Zimmer Nexgen



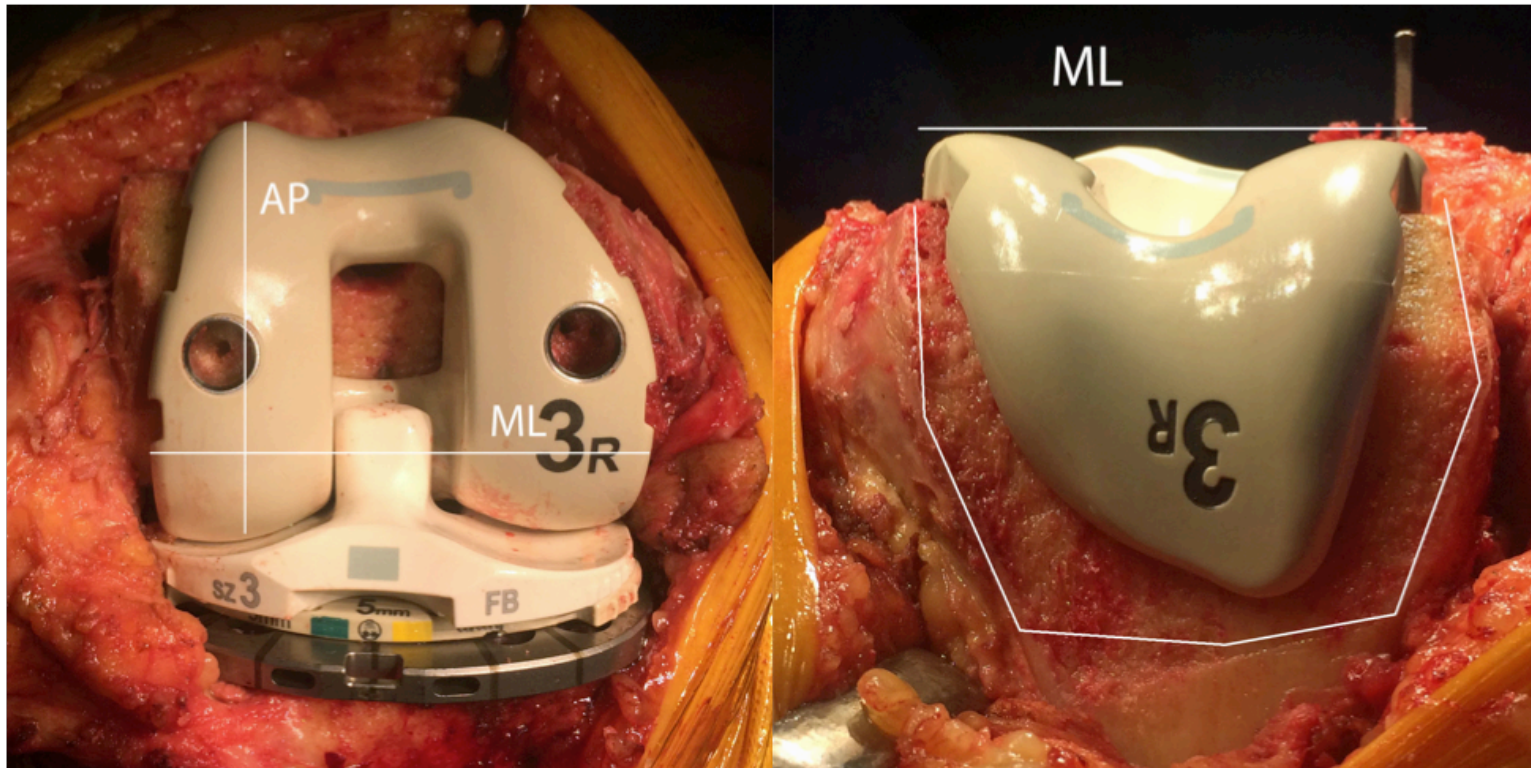
Stryker Scorpio

Digitized explants database
Implants are too rectangular

How many sizes / shapes do we need now?



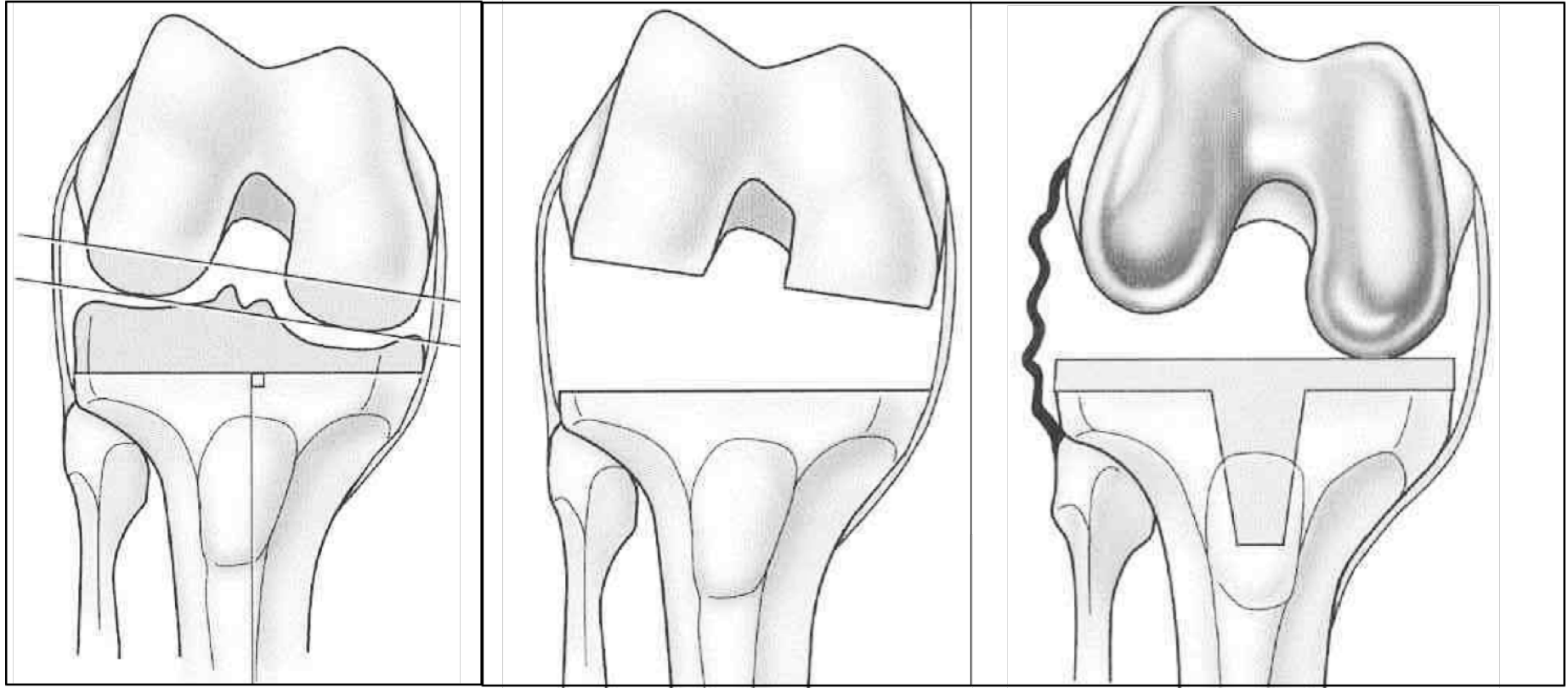
Proportional evolution (even millimetric increment) do not solve the problem...



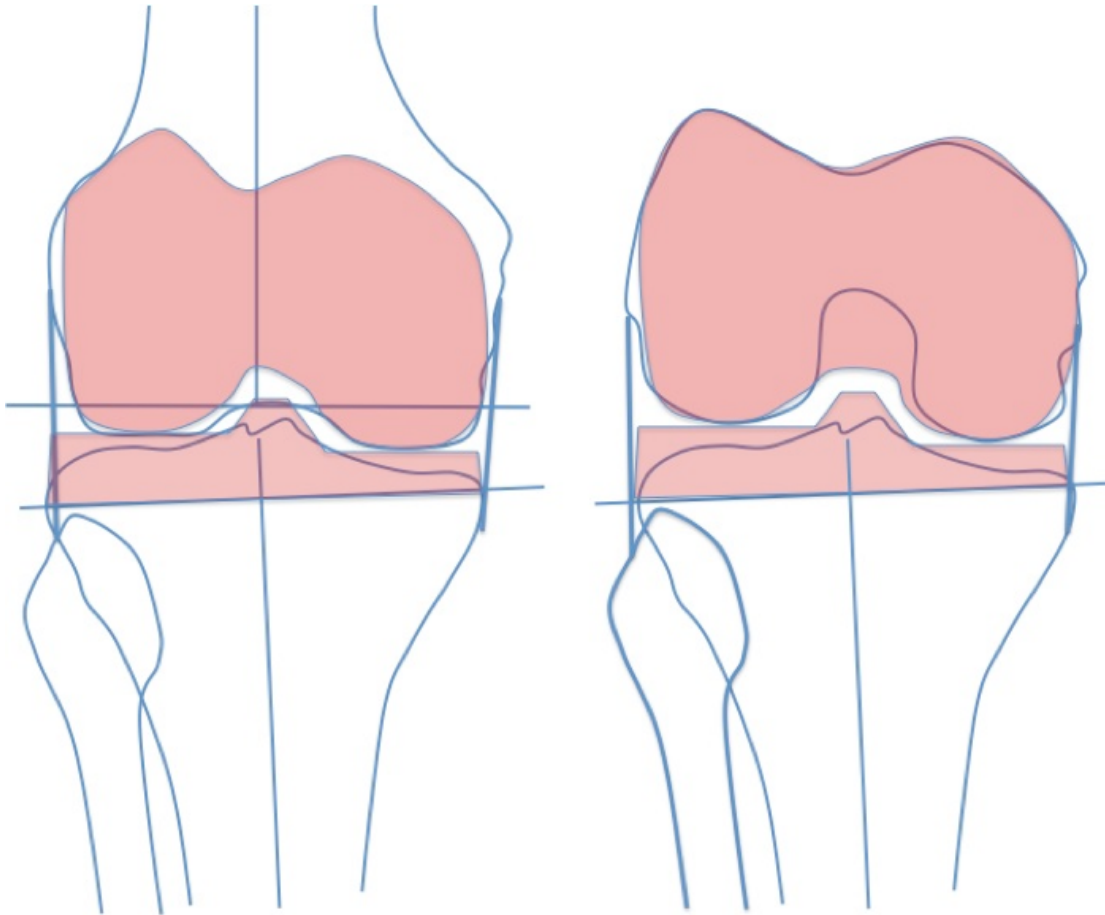
3

... Gap balancing ...

Gap balancing?

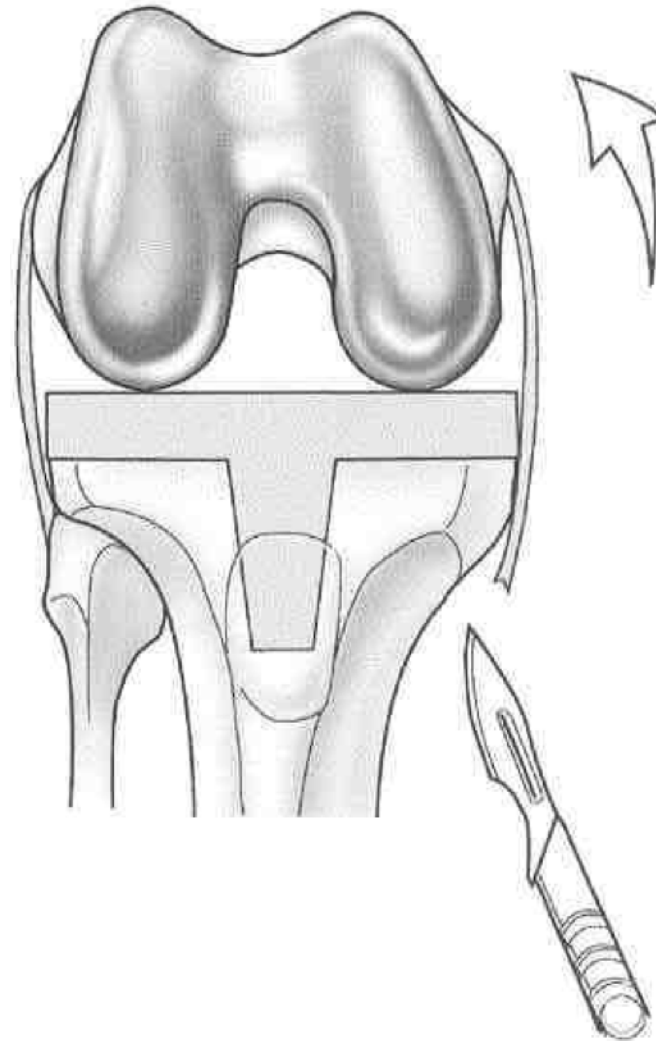


‘The world according to Gap’



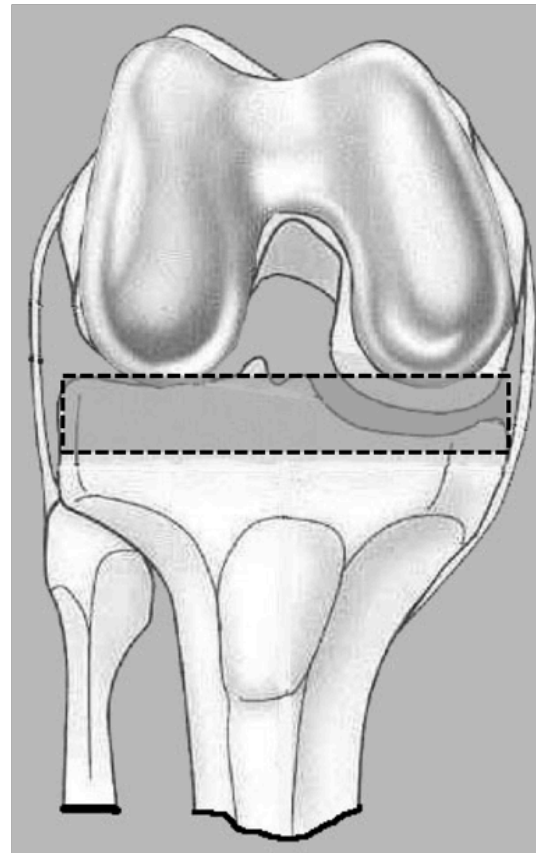
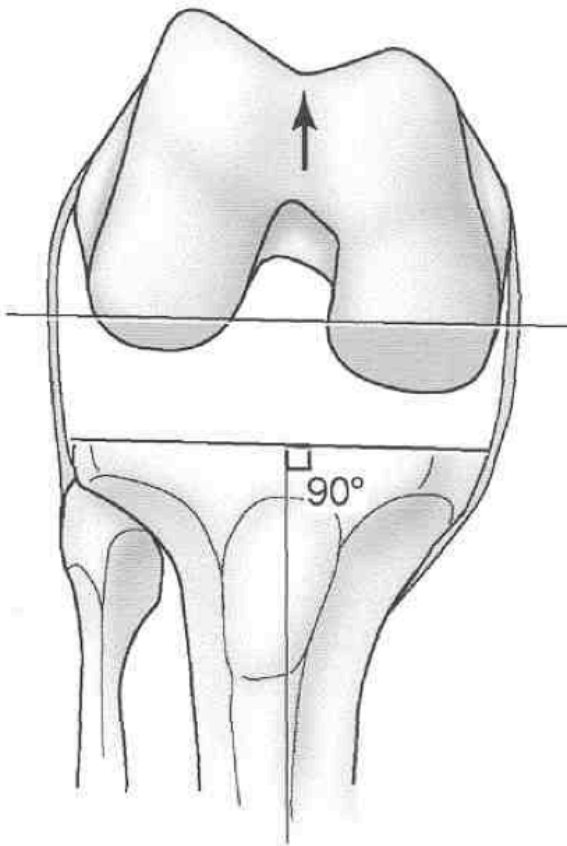
‘ligament release’

Adapt the soft-tissue to the non-anatomic prosthesis



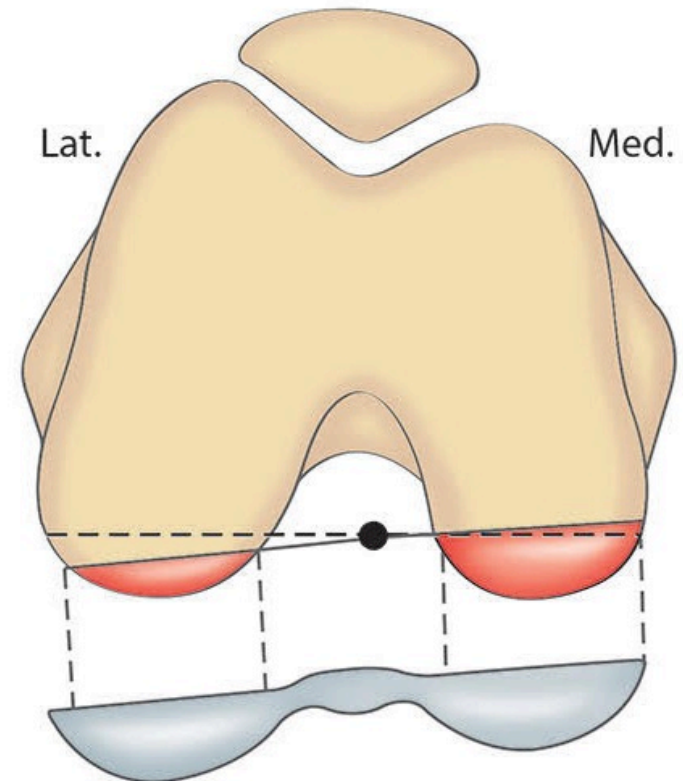
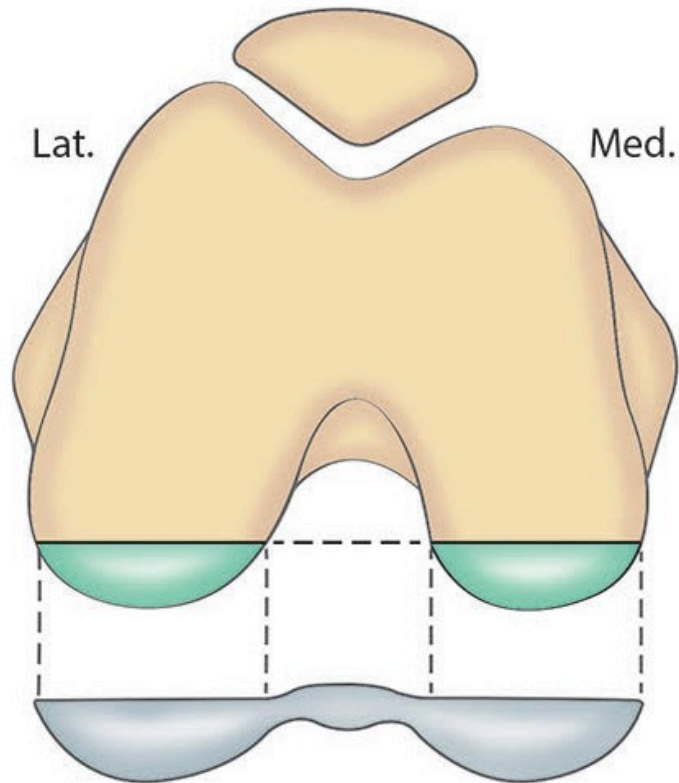
‘Femoral rotation’

Adapt the position of the non-anatomic prosthesis in the envelope



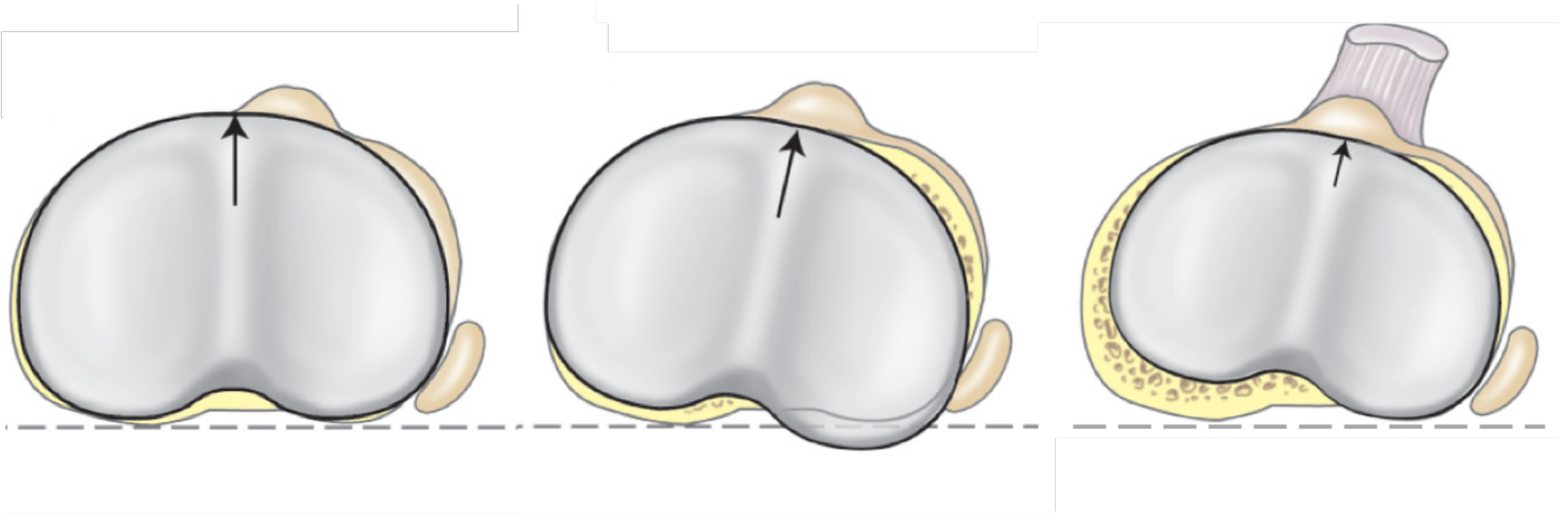
‘Femoral rotation’

Bonnin et al. BJJ 2017



‘Tibial rotation’

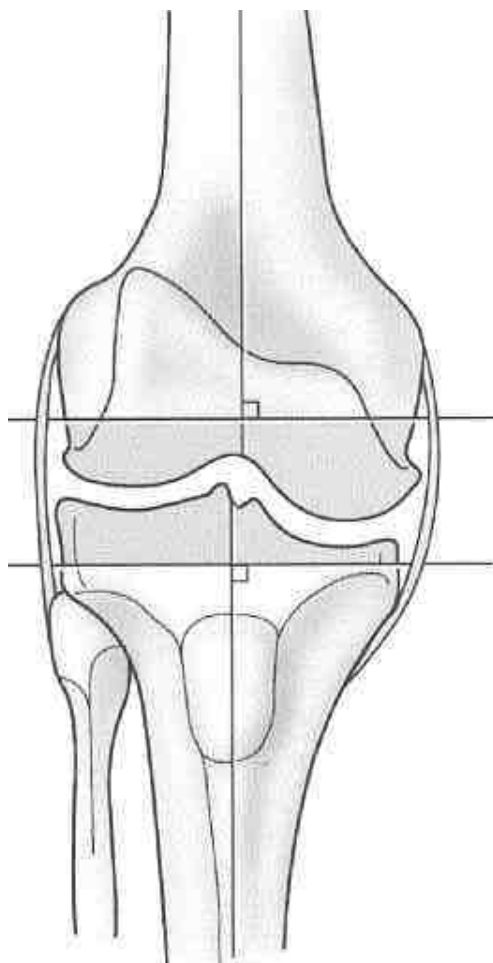
Bonnin et al. JoA 2010
Bonnin et al KSSTA 2015



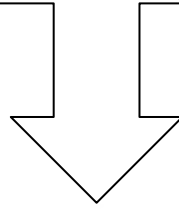
4

...Alignment...

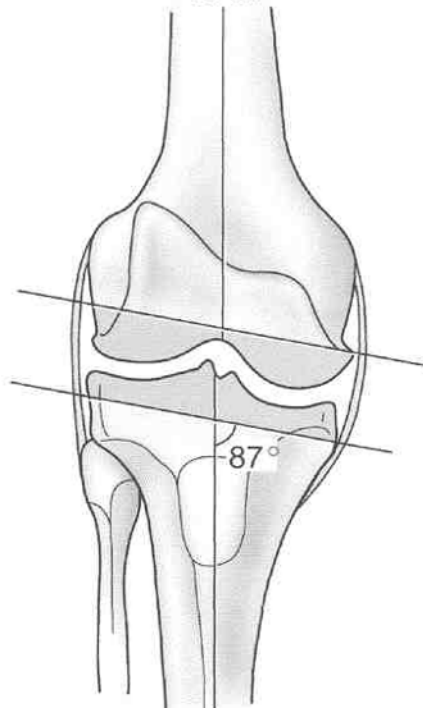
Mechanical alignment (*J Insall*)



Mechanical alignment (*J Insall*)



Anatomic alignment (*Hungerford and Krackow*)



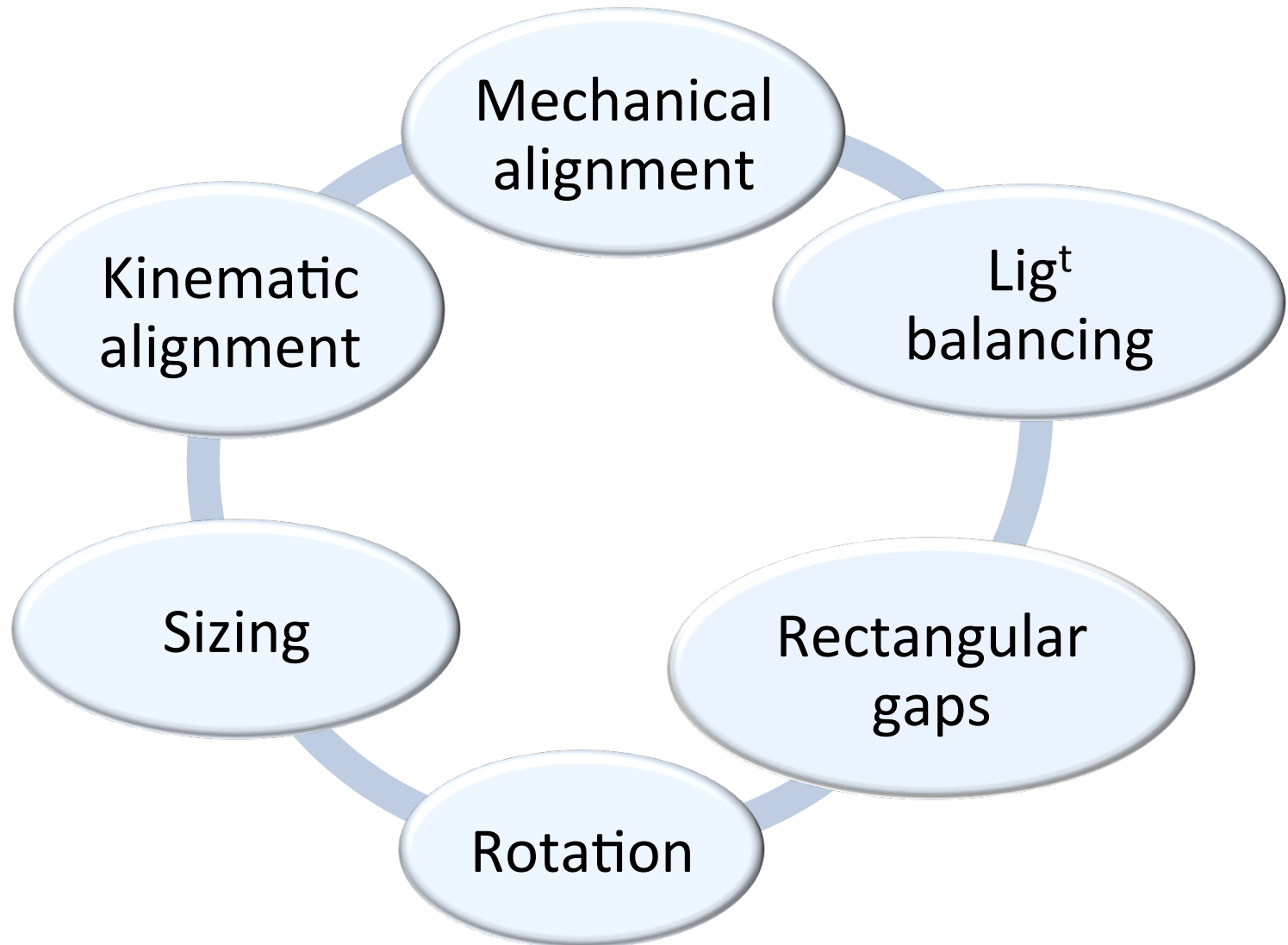
Mechanical alignment (*J Insall*)

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graph TD; A[Mechanical alignment (J Insall)] --> B[Anatomic alignment (Hungerford and Krackow)]; B --> C[Kinematic alignment (S Howell)];
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Anatomic alignment (*Hungerford and Krackow*)

Kinematic alignment (*S Howell*)

A non anatomic implant in a non extensible enveloppe

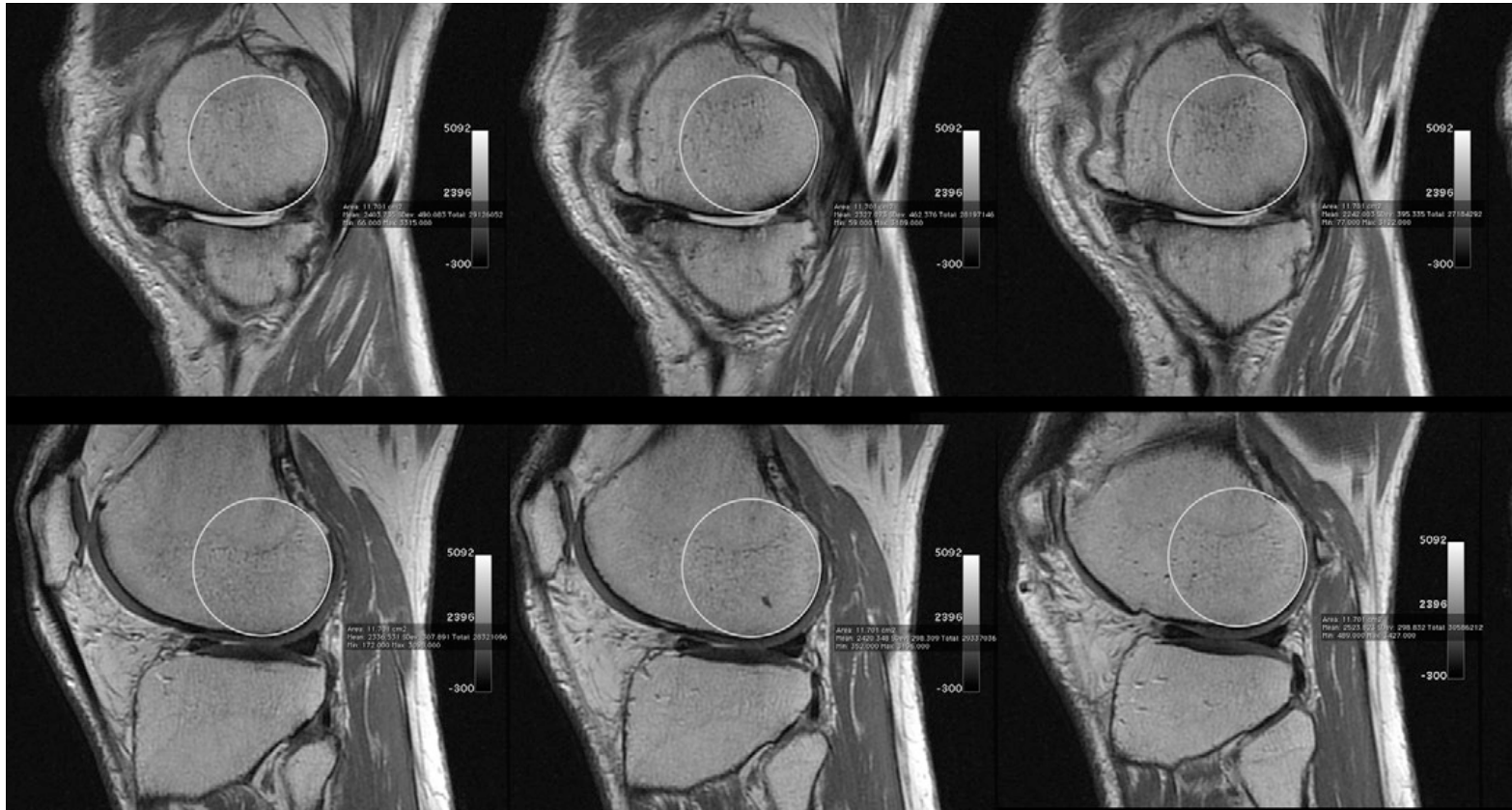


5

... Kinematics ...

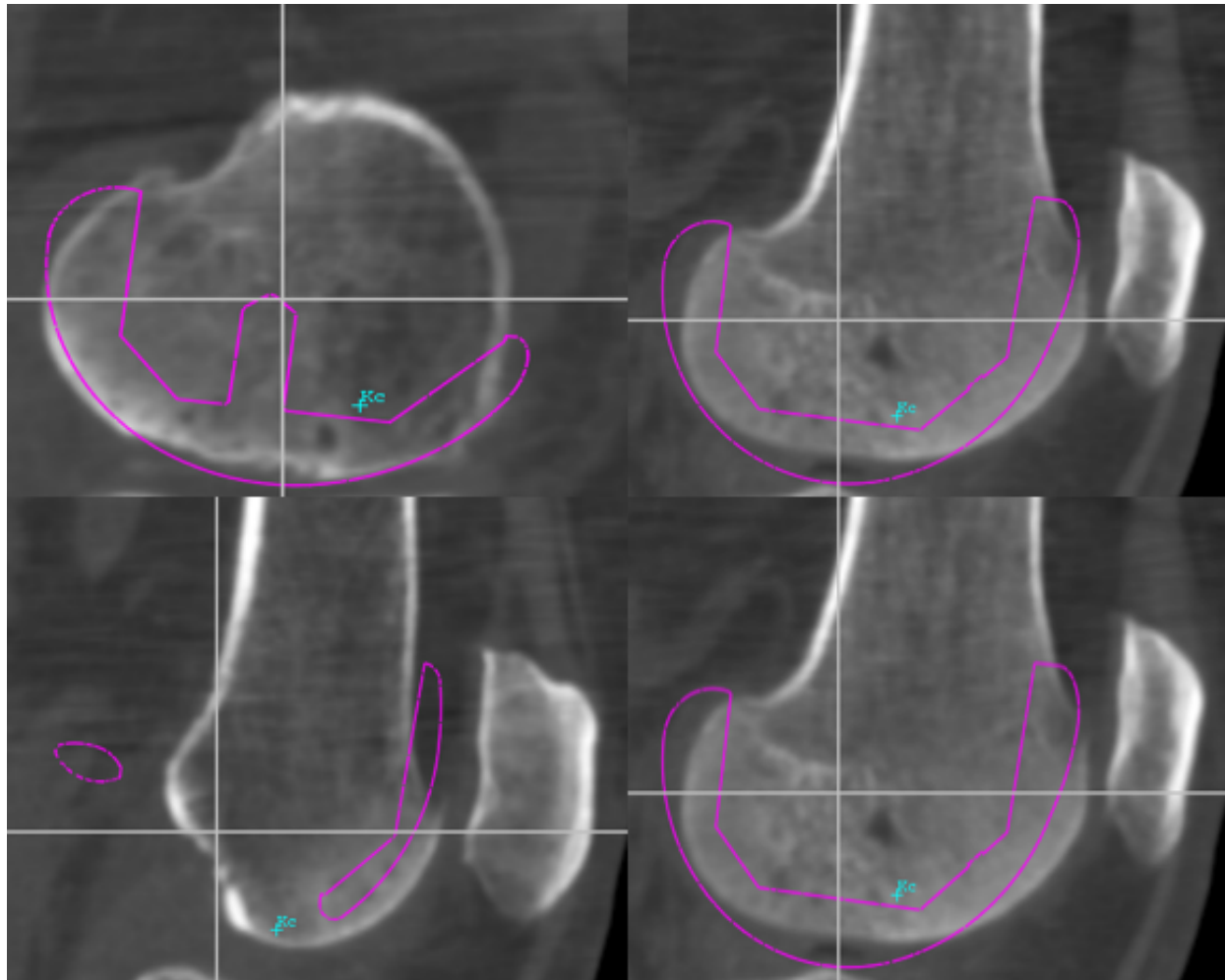
Multiradius vs Single radius?

Hollister CORR 1993, Howell et al. JBJS Am 2010, Monk et al. BJJ 2014

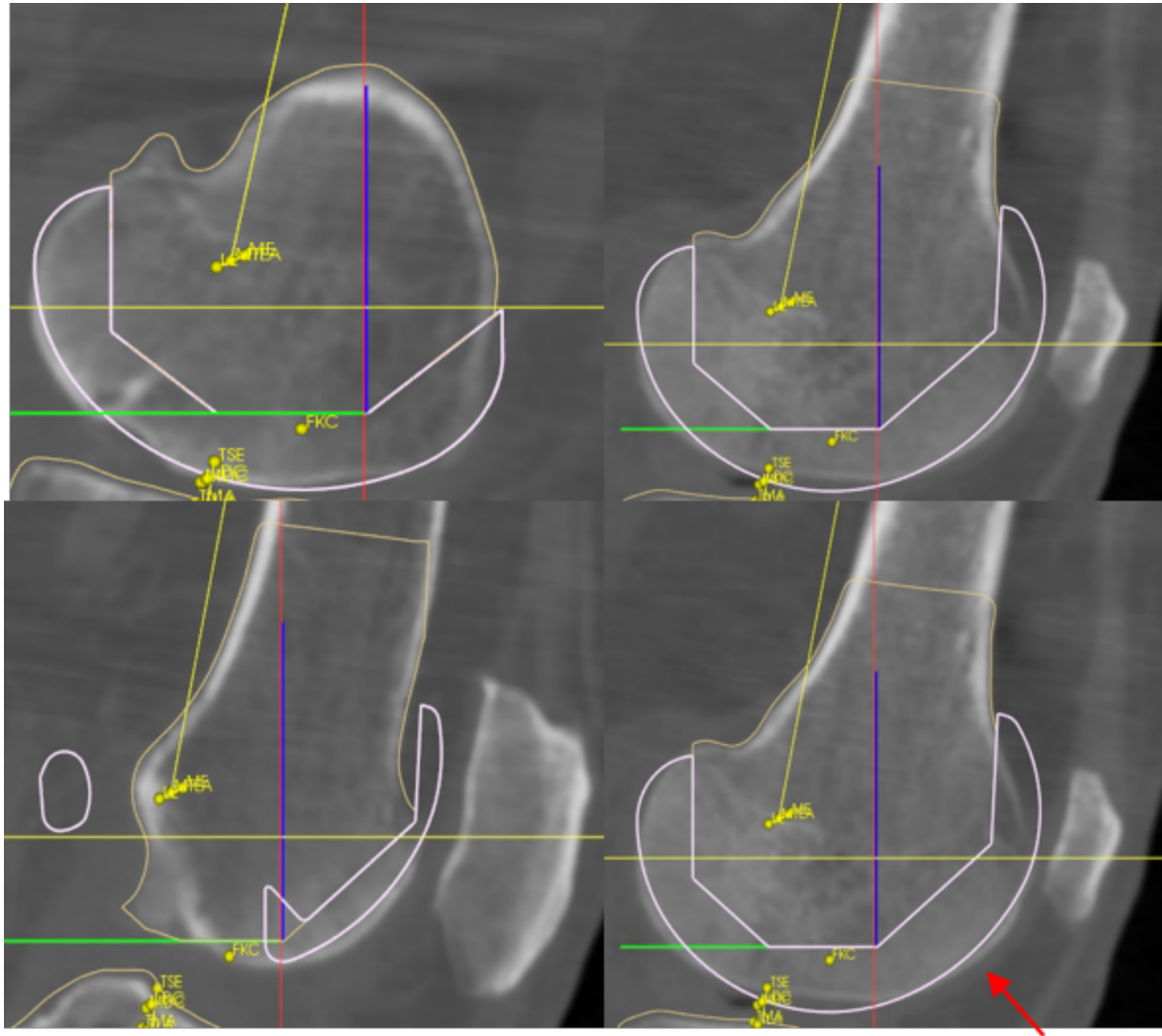


Some knees are multiradius others are single radius

Matching contours with 'standard implants'



Matching contours with 'custom implants'



6

*...Were do we stand
today?...*

year

Science and industry

1960

- *Satellites*
- *Man on the moon*

1970

- *Personal Computers*

1980

- *Spaceships*

1990

- *Kasparov / Deep Blue*
- *Internet*
- *International space station*

2000

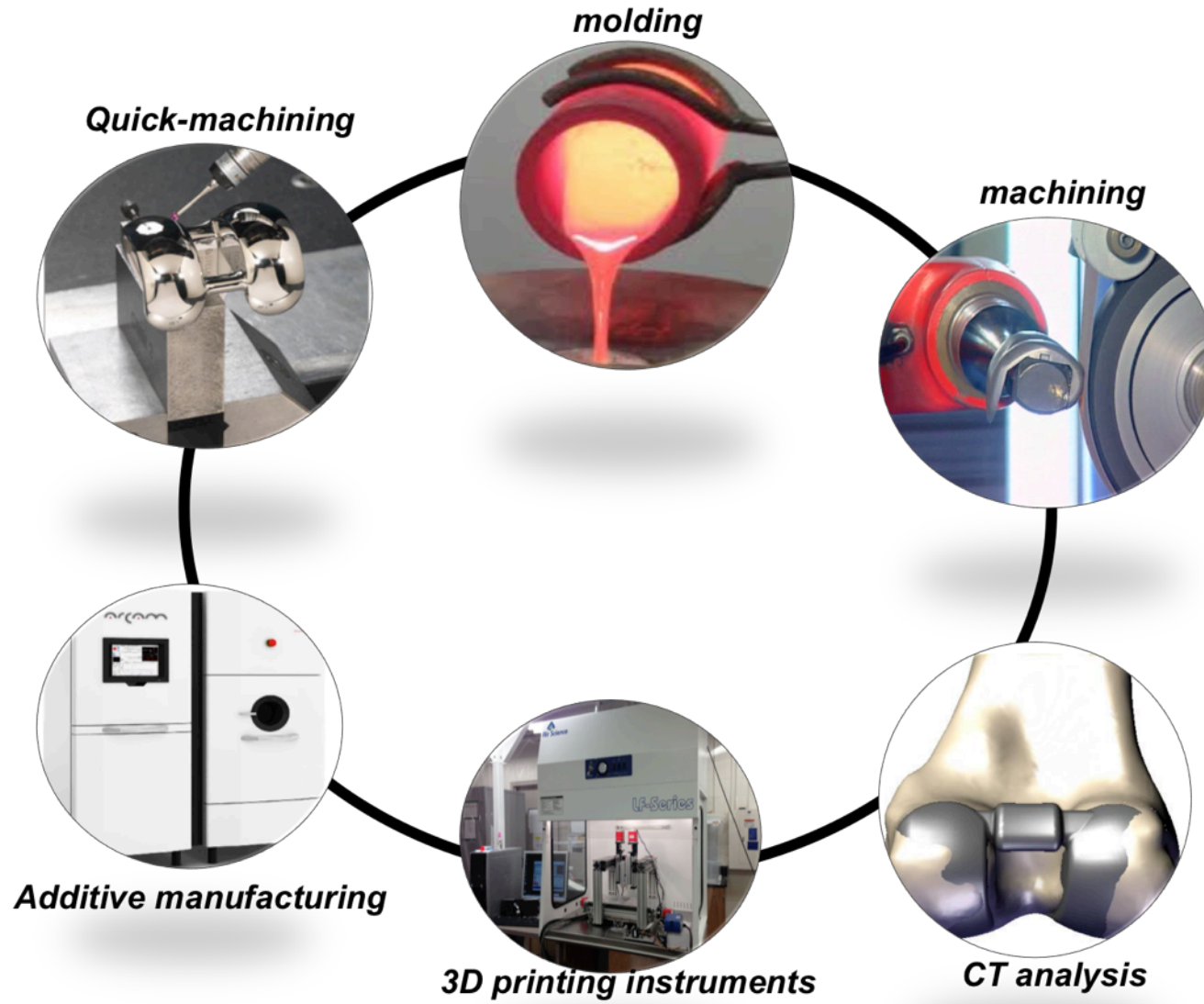
- *Digital revolution*
- *3-D printing*

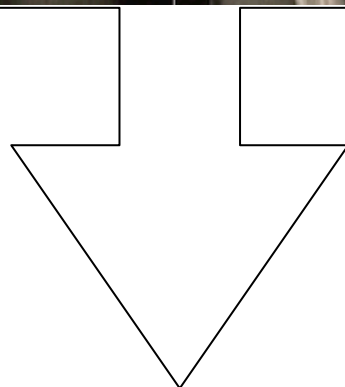
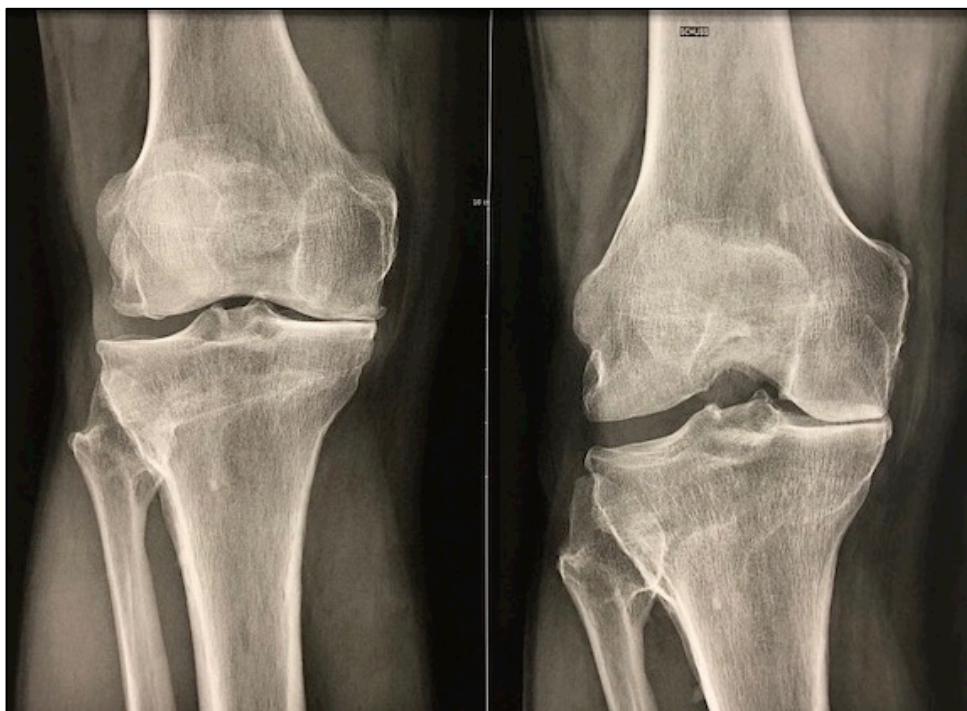
2010

- *Humanoïd robots*
- *Probes in interstellar space*

year	Science and industry	TKA manufacturing
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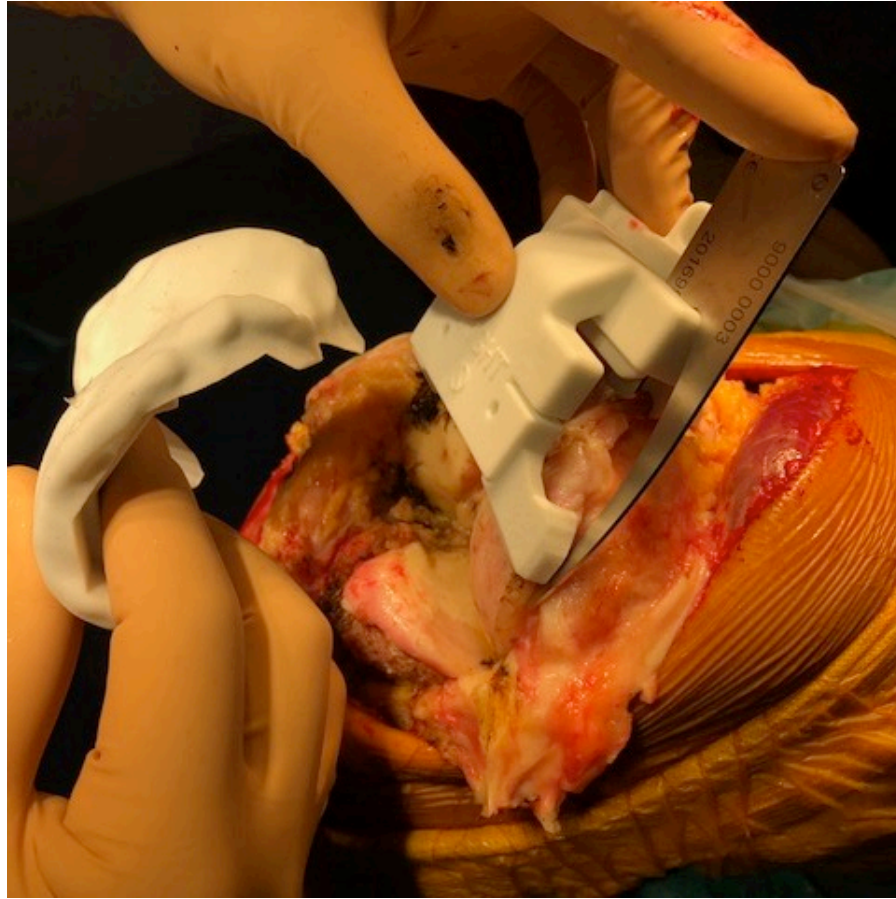
1960	<i>Satellites</i> <i>Man on the moon</i>	Pre-modern TKA era
1970	<i>Personal Computers</i>	
1980	<i>Spaceships</i>	
1990	<i>Kasparov / Deep Blue</i> <i>Internet</i> <i>International space station</i>	
2000	<i>Digital revolution</i> <i>3-D printing</i>	
2010	<i>Humanoid robots</i> <i>Probes in interstellar space</i>	





CT-Scan

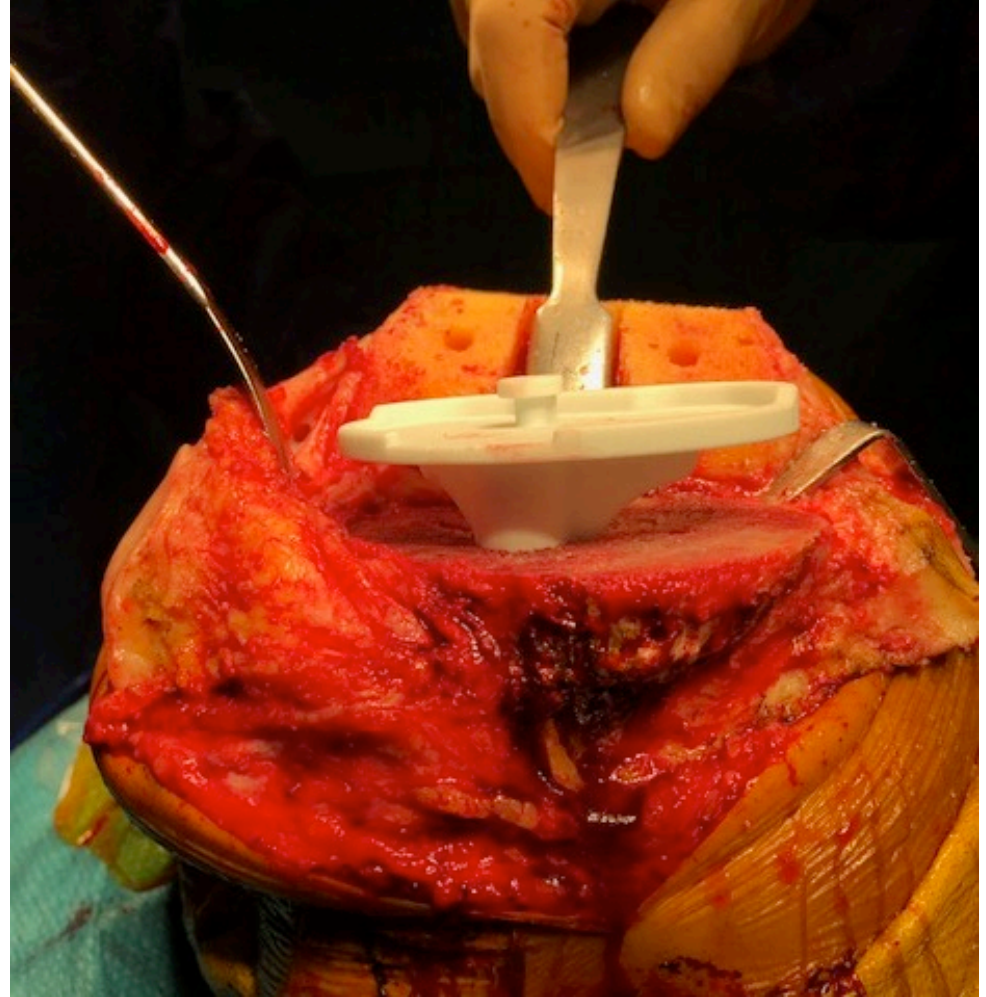
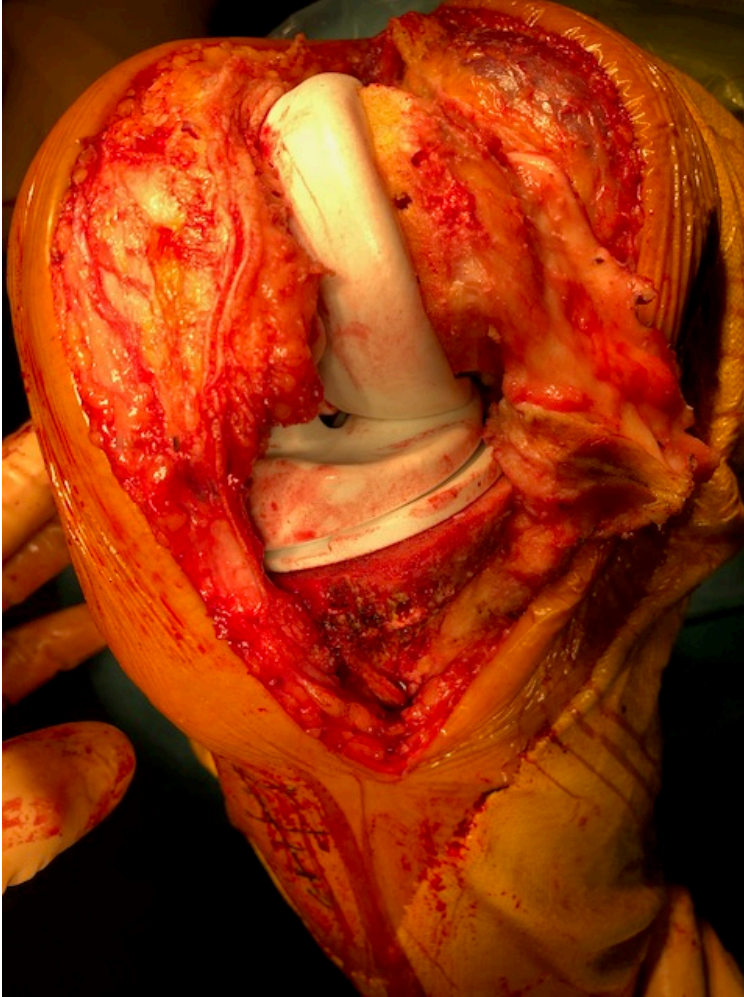
Custom guides



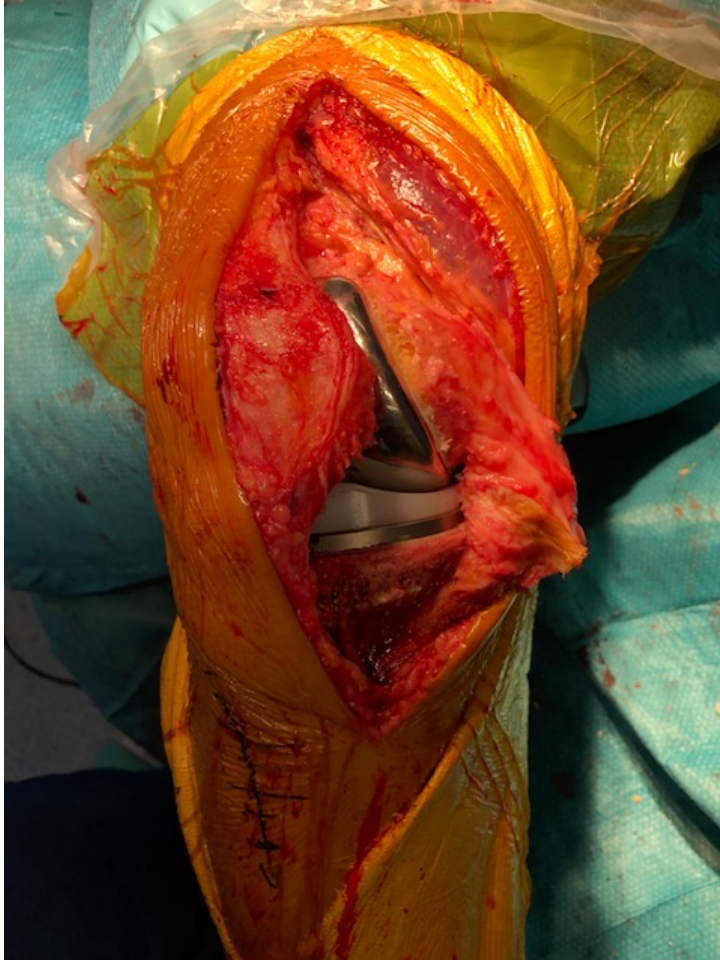
Trials



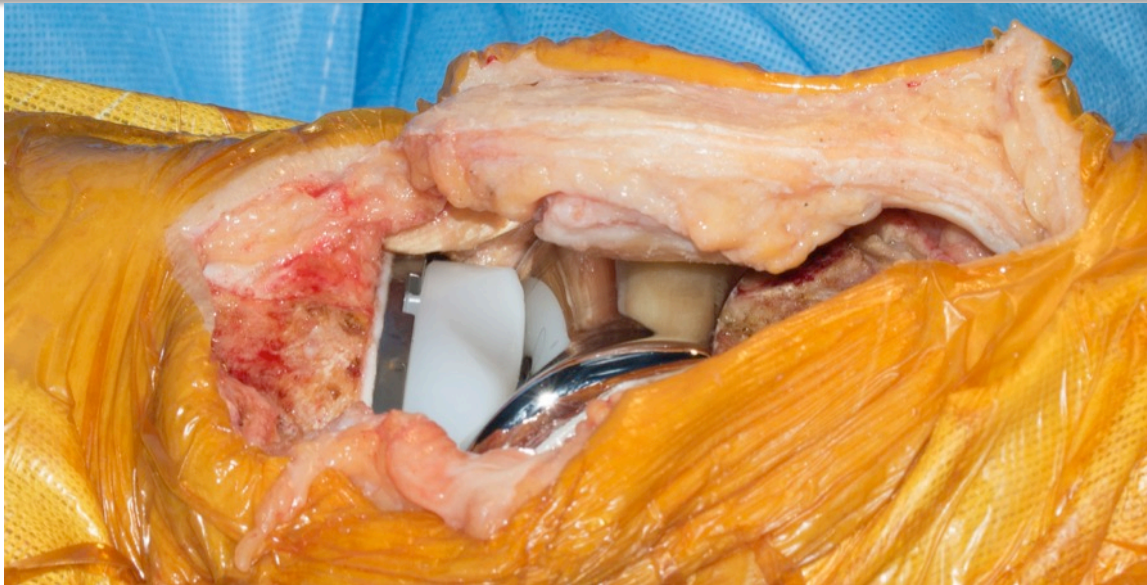
Fine tuning the level of tibial cut



Custom implants

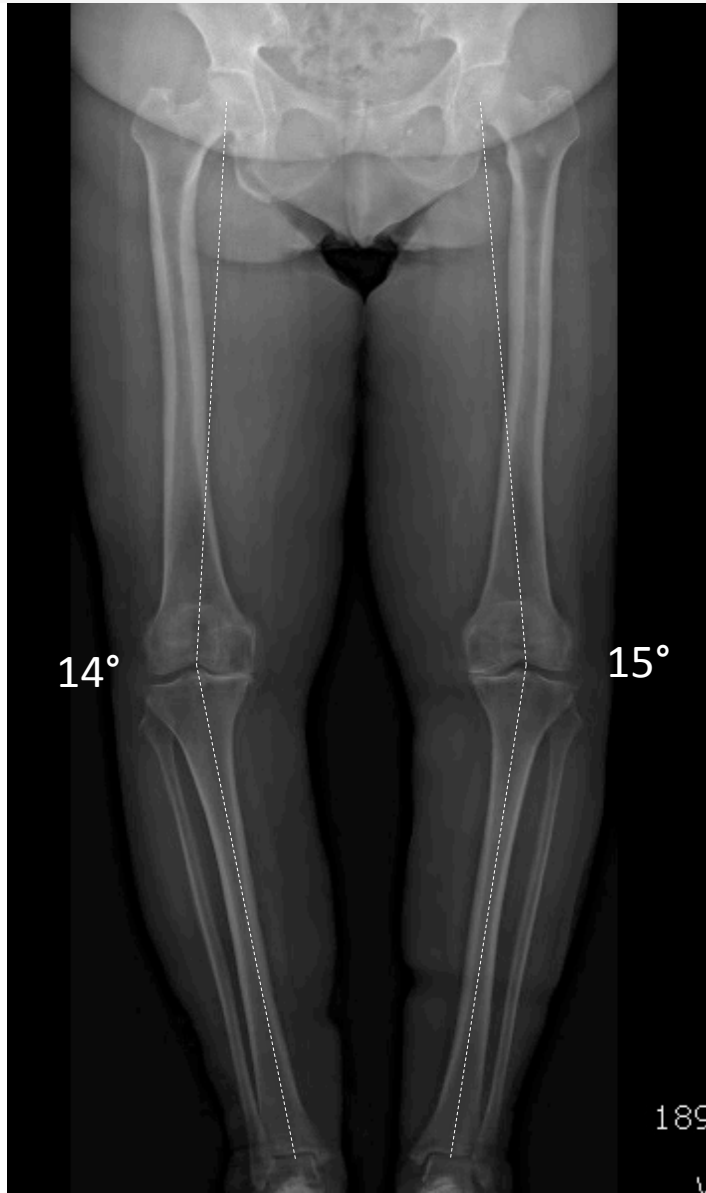


Preservation of bone stock

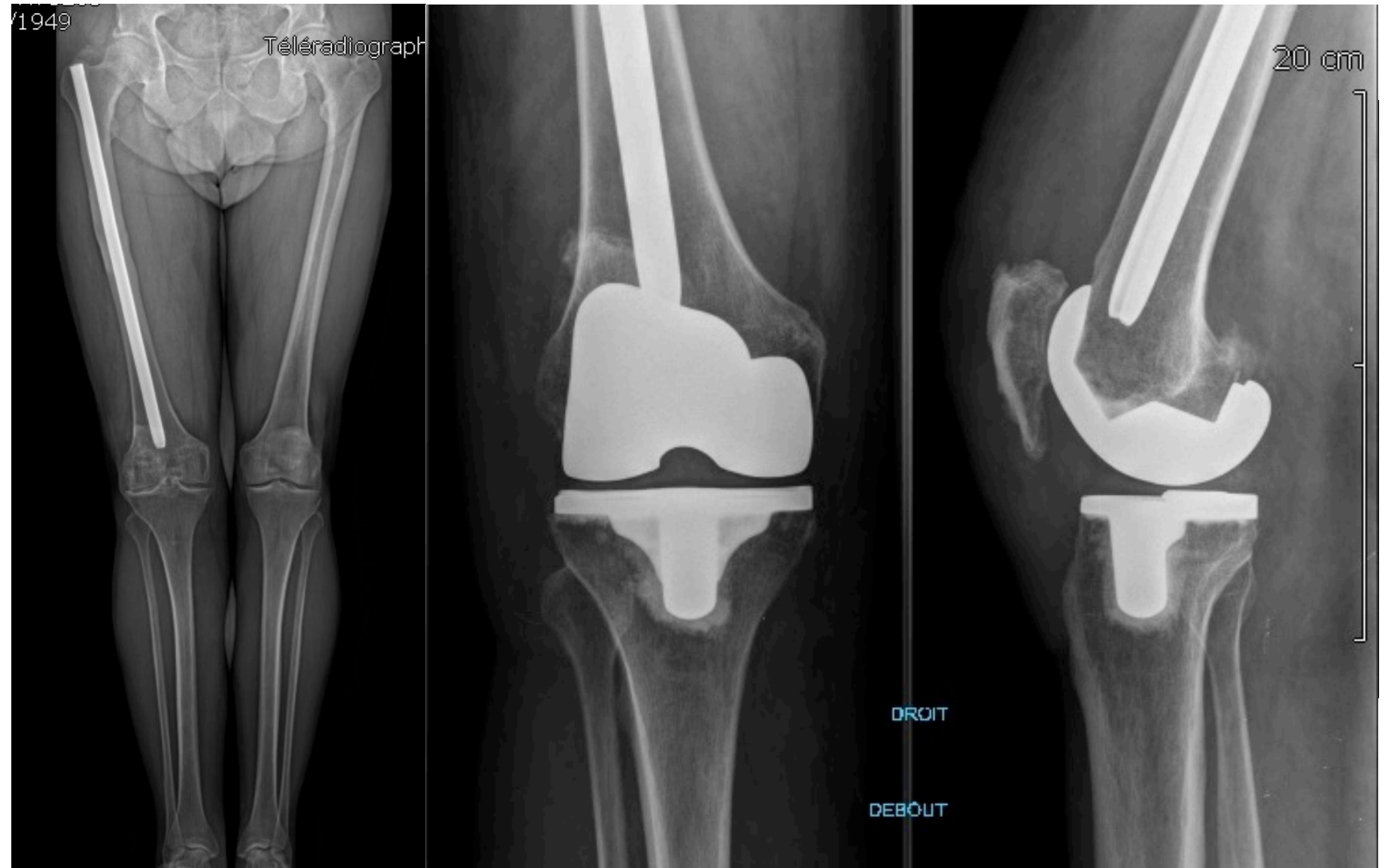


Special morphotypes

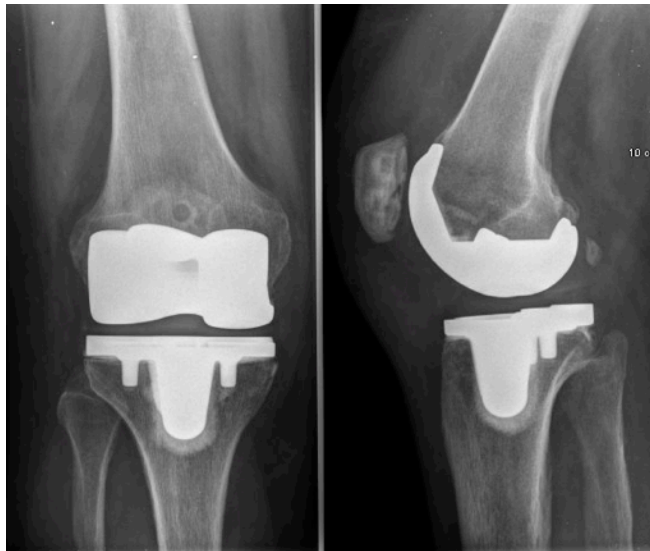
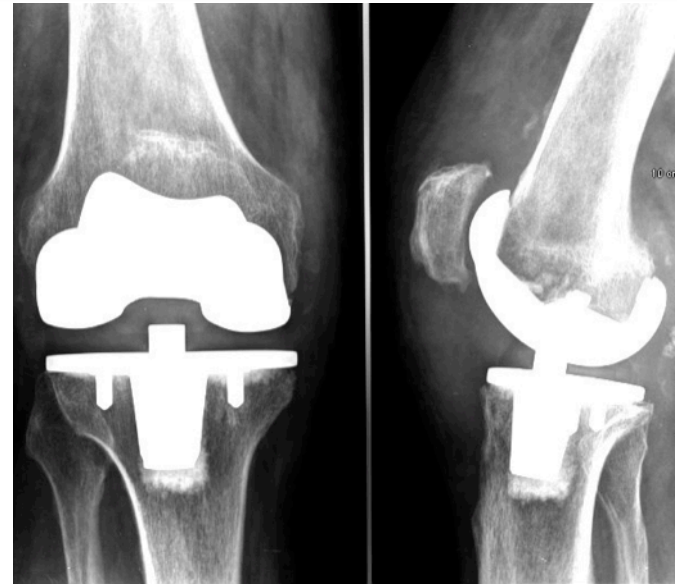
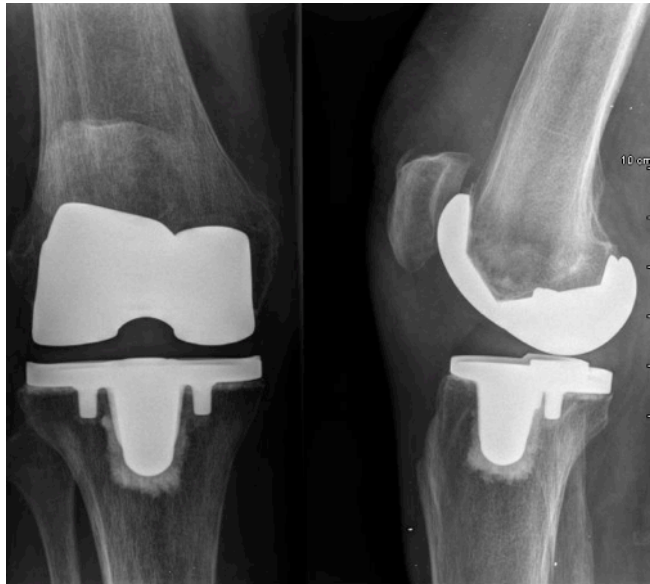
Small patient: 141cm



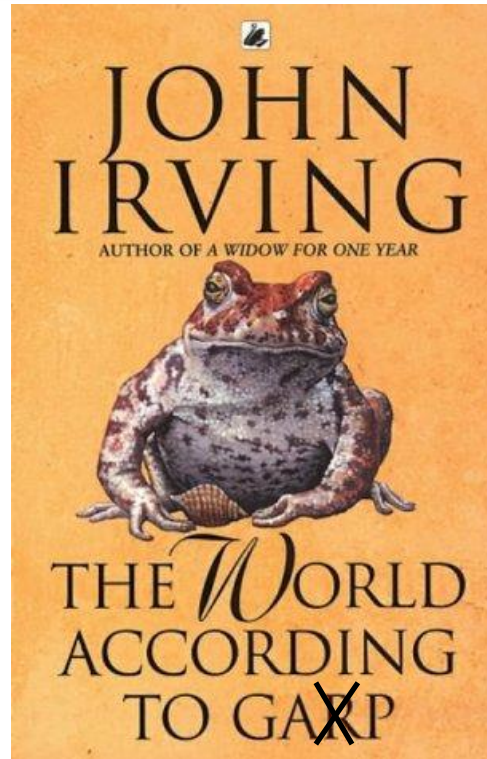
Special situations



'Standard patients'



Conclusion



“Imagining something is better than remembering something.”