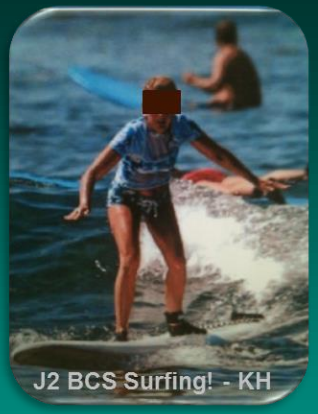
Role of Knee implant Technology in Personalizing Medicine – Should One implant Fit All?

Michael D. Ries, M.D.

Disclosure

- Consultant with intellectual property (royalties)
- Smith and Nephew

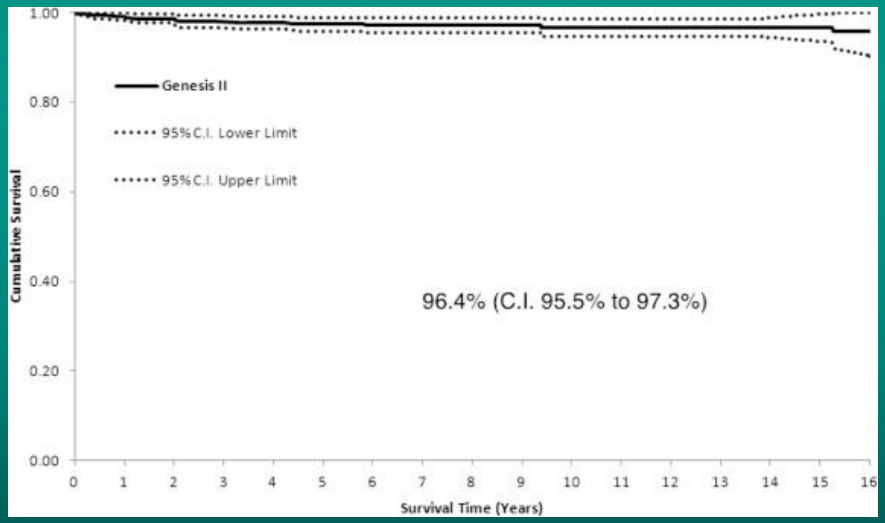
Goals of TKA



- Pain relief
- Durability

…and they want →

- better function



McCalden RW, Hart GP, MacDonald SJ, Naudie DD, Howard JH. Clinical Results and Survivorship of the GENESIS II Total Knee Arthroplasty at a Minimum of 15 Years. J Arthroplasty 2017

Current results of TKA

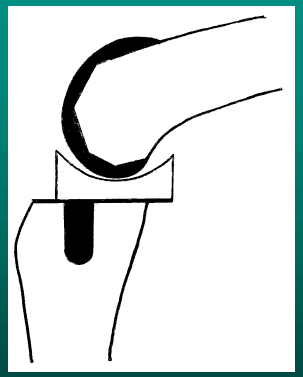
- Predictable pain relief
- > 95% ten year survivorship
- Higher demand functional activities restricted

Implant options

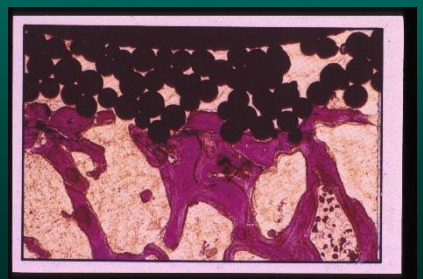
- CR

- PS

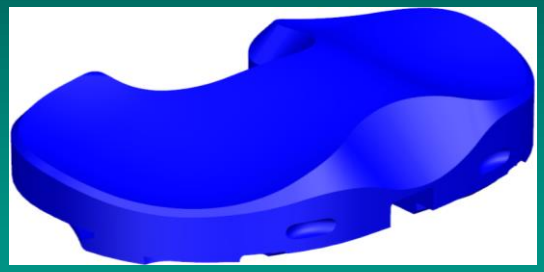
- Bicruciate Retaining (BCR)



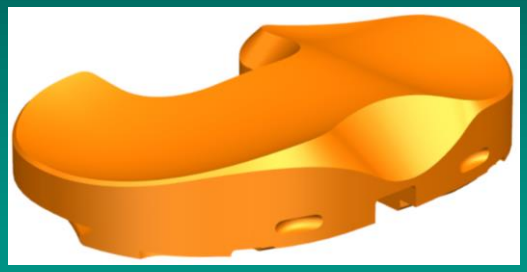
- Mobile Bearing
- Cementless



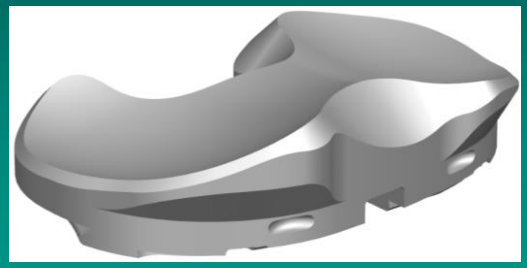
CR insert options



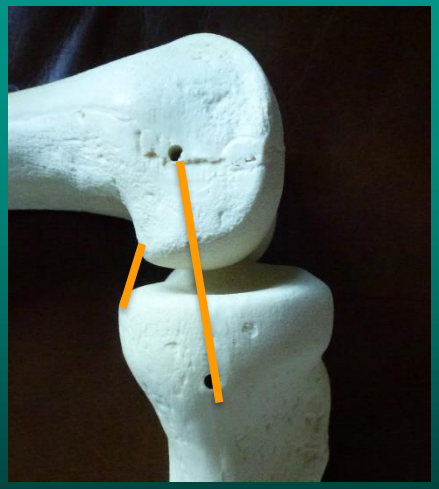
standard

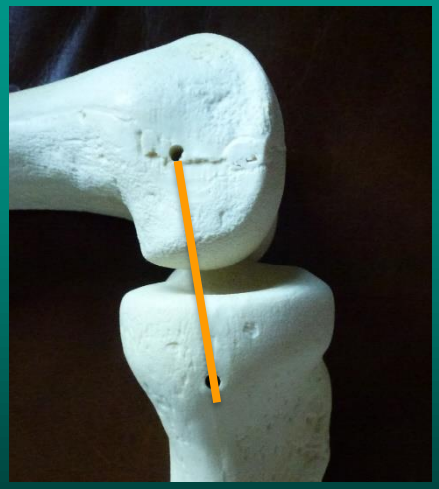


medial dished



dished

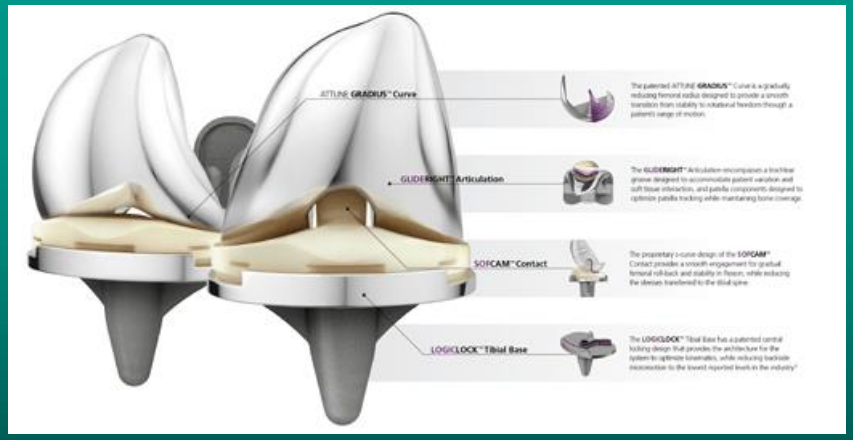




Lots of sizes

Persona
21 Femoral sizes
9 Tibial sizes

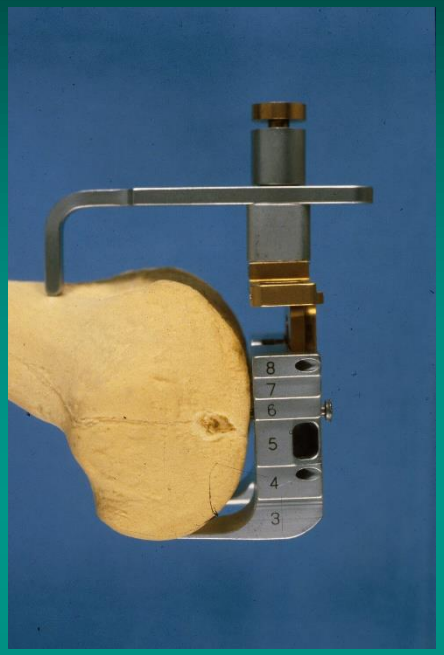
Conformis
custom
implants



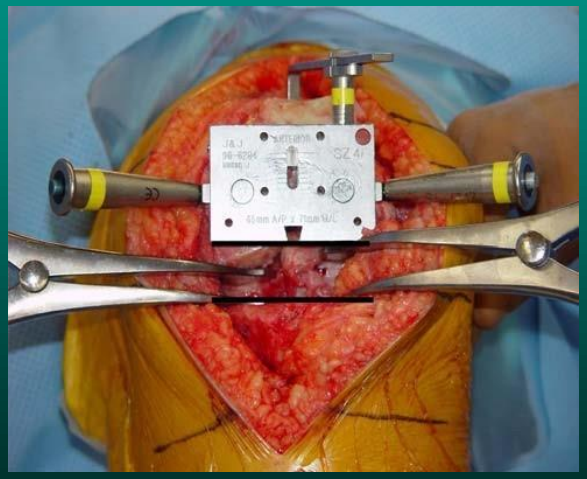
Attune
14 Femoral sizes
10 Tibial sizes

Soft tissue balancing

- Measured resection



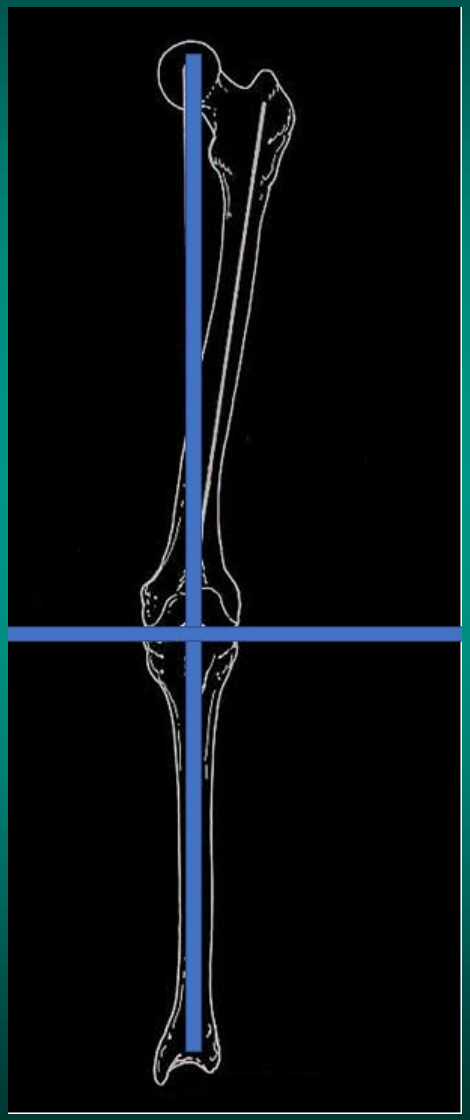
- Gap balancing



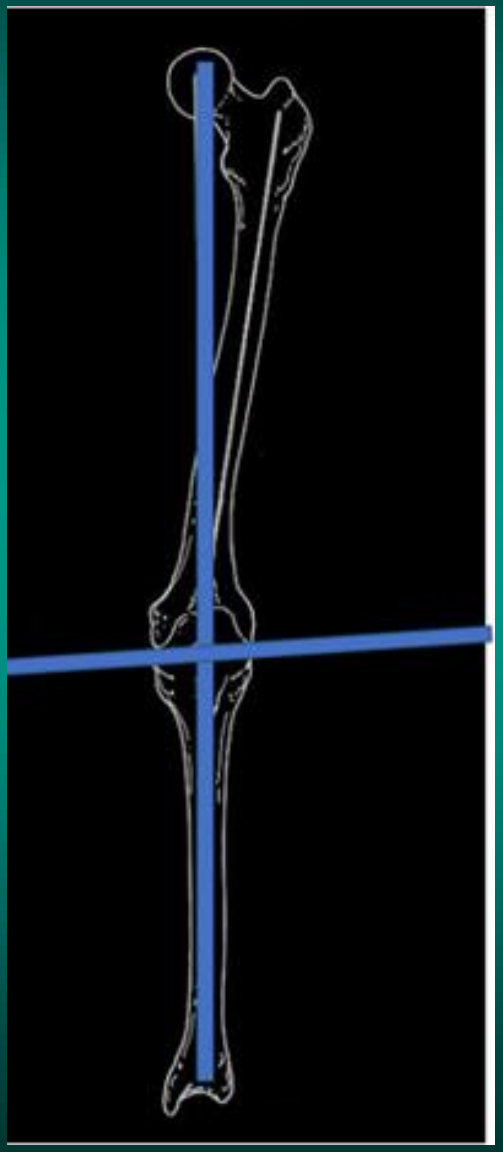
Balanced (90 degree) flexion and extension spaces

Alignment :

Mechanical



Kinematic



Navigation and Robotics

So what is the problem we are trying to fix?

- **Patients are younger – they need a durable TKA**
- **Patients are more active – they need a stable TKA**

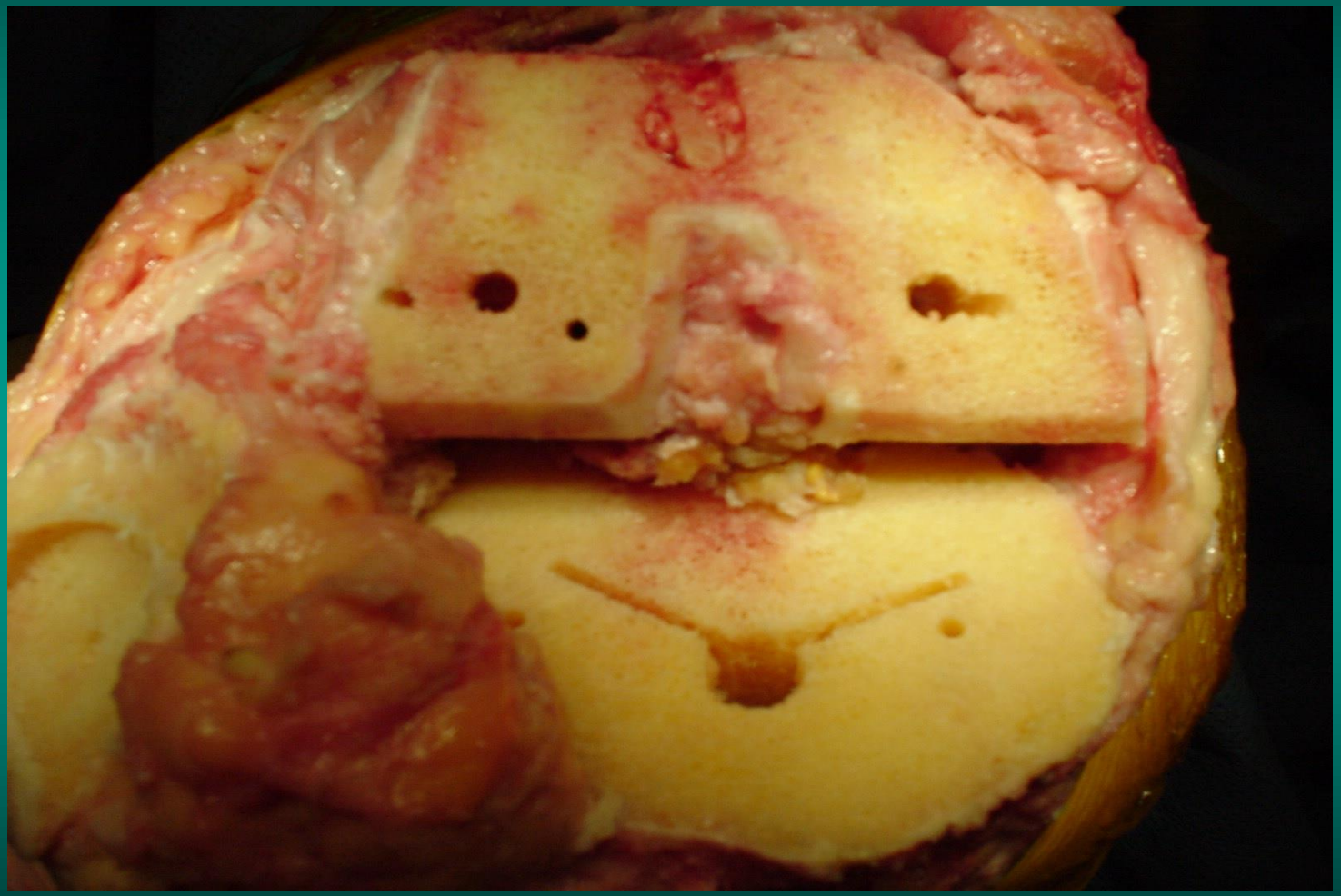
Tibia's can loosen

- Fang DM, Ritter MA, Davis KE. Coronal alignment in total knee arthroplasty: just how important is it? J Arthroplasty, 24(6 Suppl):39-43, 2009.
- Fehring TK, Fehring KA, Anderson LA, Otero JE, Springer BD. Catastrophic Varus Collapse of the Tibia in Obese Total Knee Arthroplasty. J Arthroplasty, 32:1625-1629, 2017.

Tibial loosening

- Better cement
- Better cement technique
- Tibial stem extension
- Porous ingrowth tibia

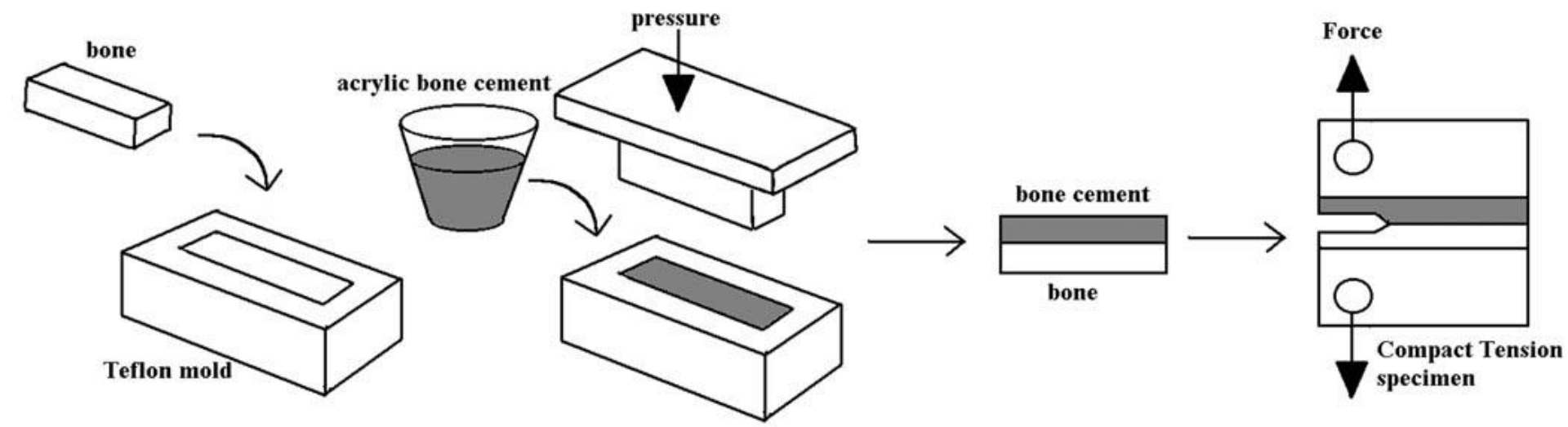
Cement Fixation in TKA



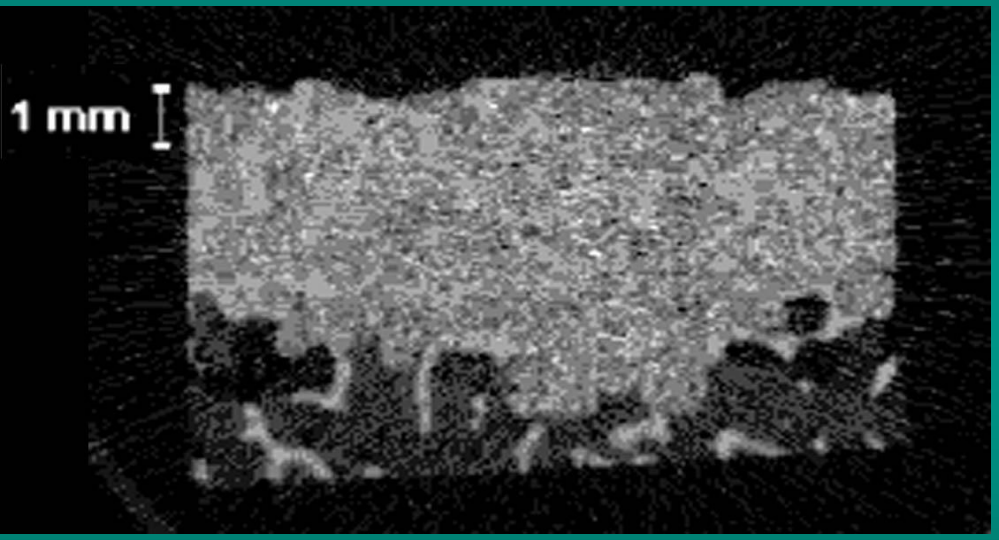
Cancellous bone

Effect of Bone Porosity on Mechanical Integrity of the Bone Cement-Interface. Graham J, Ries M, Pruitt L:

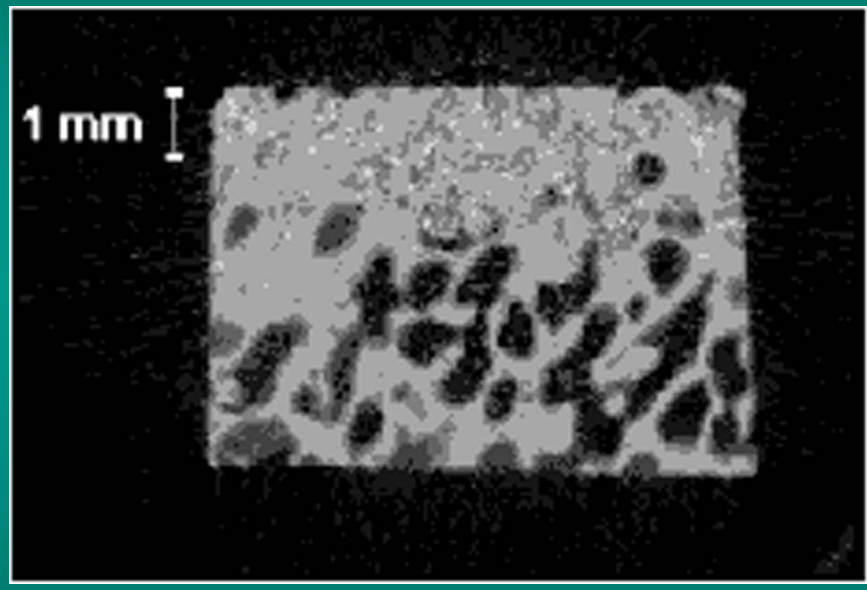
JBJS 85A, 2003



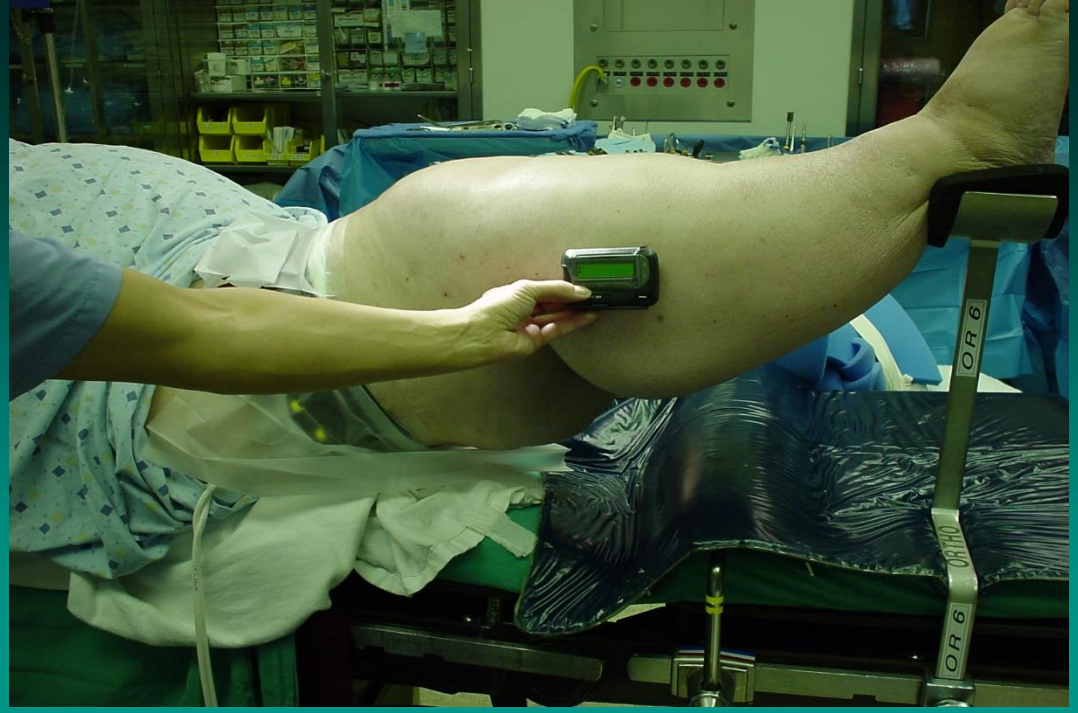
Cement penetration

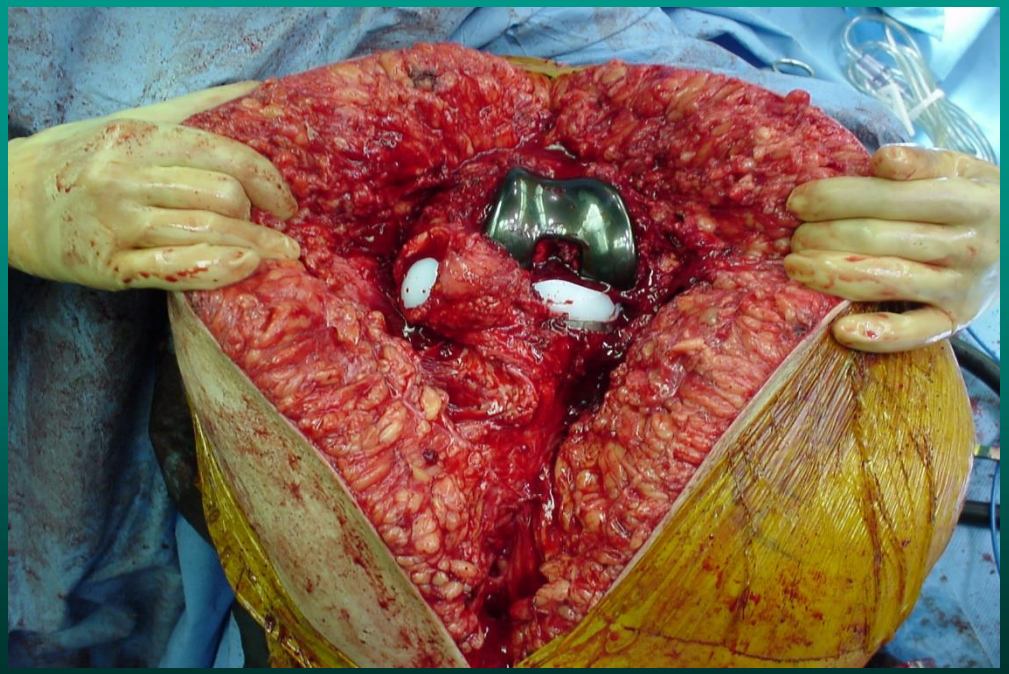


osteoporotic



dense





Tibial stem extension

Hegde V, Bracey DN, Brady AC, Kleeman-Forsthuber LT, Dennis DA, Jennings JM. A Prophylactic Tibial Stem Reduces Rates of Early Aseptic Loosening in Patients with Severe Preoperative Varus Deformity in Primary Total Knee Arthroplasty. J Arthroplasty. 2021

- 67 patients with a preoperative varus deformity of >8 degrees and stemmed tibial component matched 1:2 to patients with a similar preoperative varus deformity with a standard tibial component (n = 134).

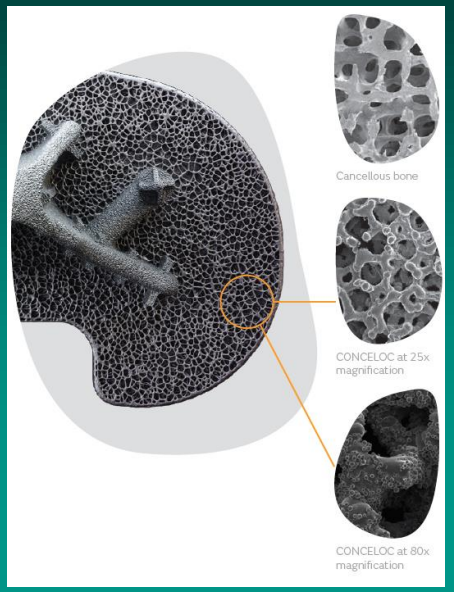
- Rates of aseptic loosening were lower in the stem group (0% vs 5.15%, P = .05).

Prasad AK, Tan JSH, Bedair HS, Dawson-Bowling S, Hanna SA. Cemented vs. cementless fixation in primary total knee arthroplasty: a systematic review and meta-analysis. EFORT Open Rev. 2020

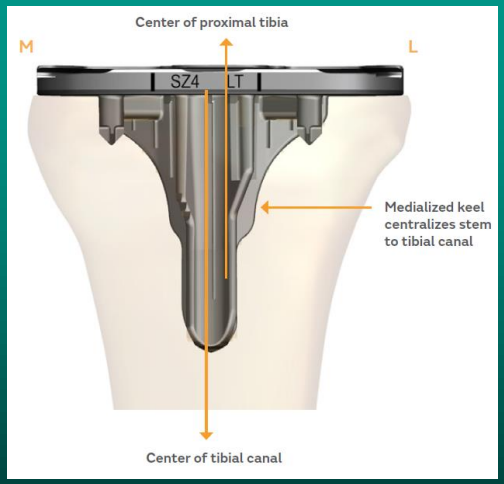
- **Meta-analysis to compare the outcomes of cemented and cementless fixation in primary TKR.**

- **No significant difference in revision rates and knee function in cemented versus cementless TKR at up to 16.6-year follow-up.**

Improved Porous Coatings

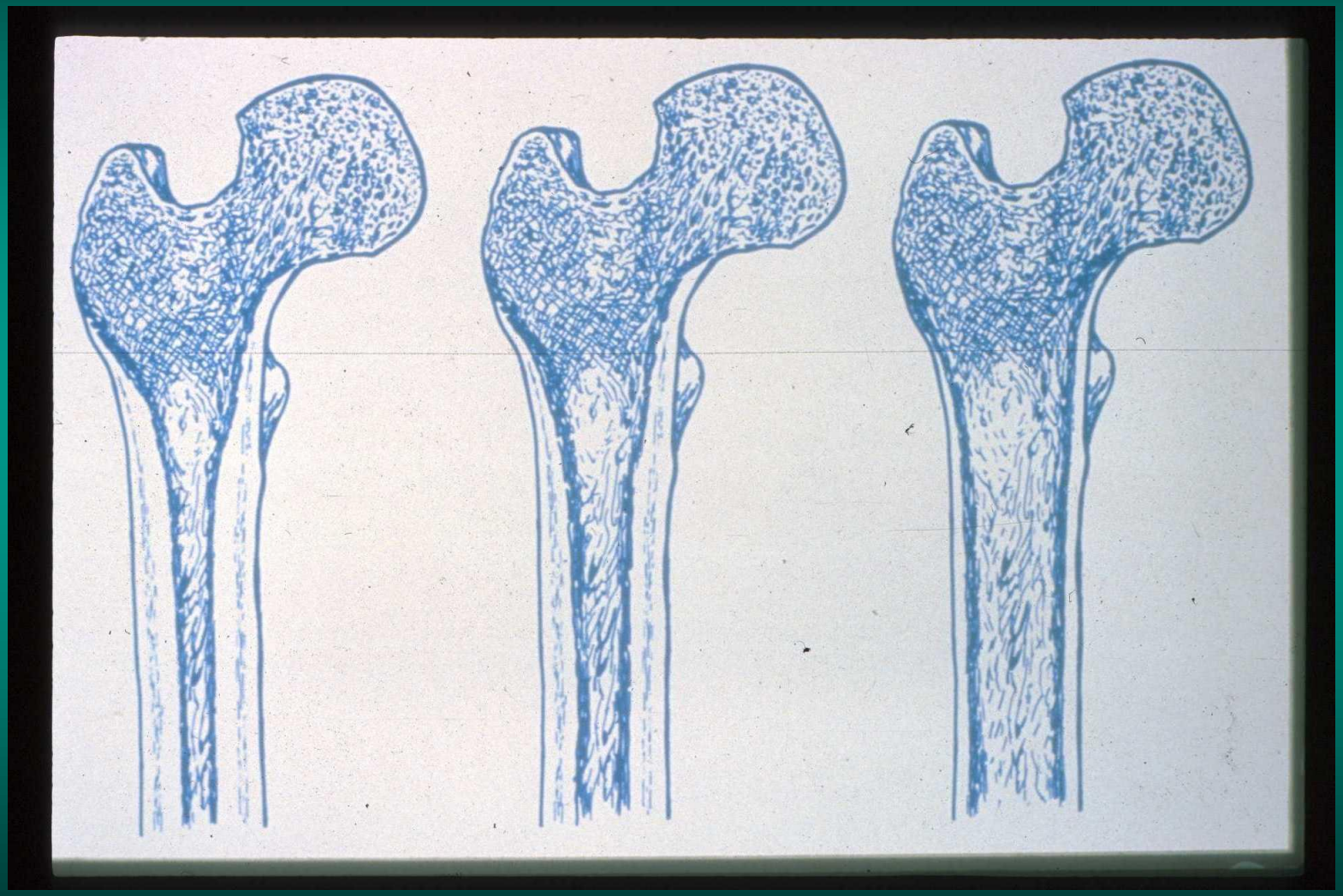


R. Meneghini, D. Lewallen, A. Hanssen
Use of porous tantalum metaphyseal cones for severe tibial bone loss during revision total knee replacement
J Bone Joint Surg Am, 90 (2008), pp. 78-84



Cementless primary tibia

Implant Fixation – Dorr Classification



Uncemented tibia

Cemented tibia

mid flexion instability

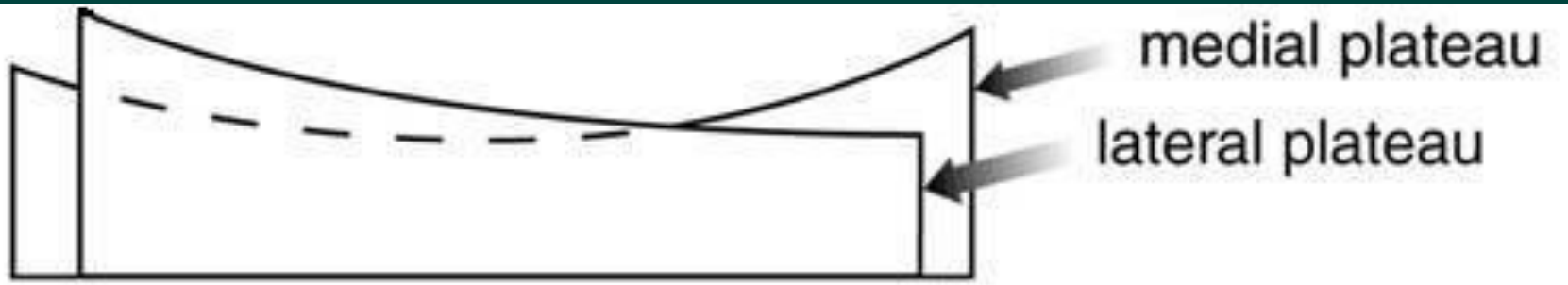
Mid flexion stability

- Retain both cruciates
- More normal kinematic designs
- Anatomic joint line
- Mid flexion soft tissue balancing (robotics, navigation, tensioners)

Bicruciate Retaining TKA

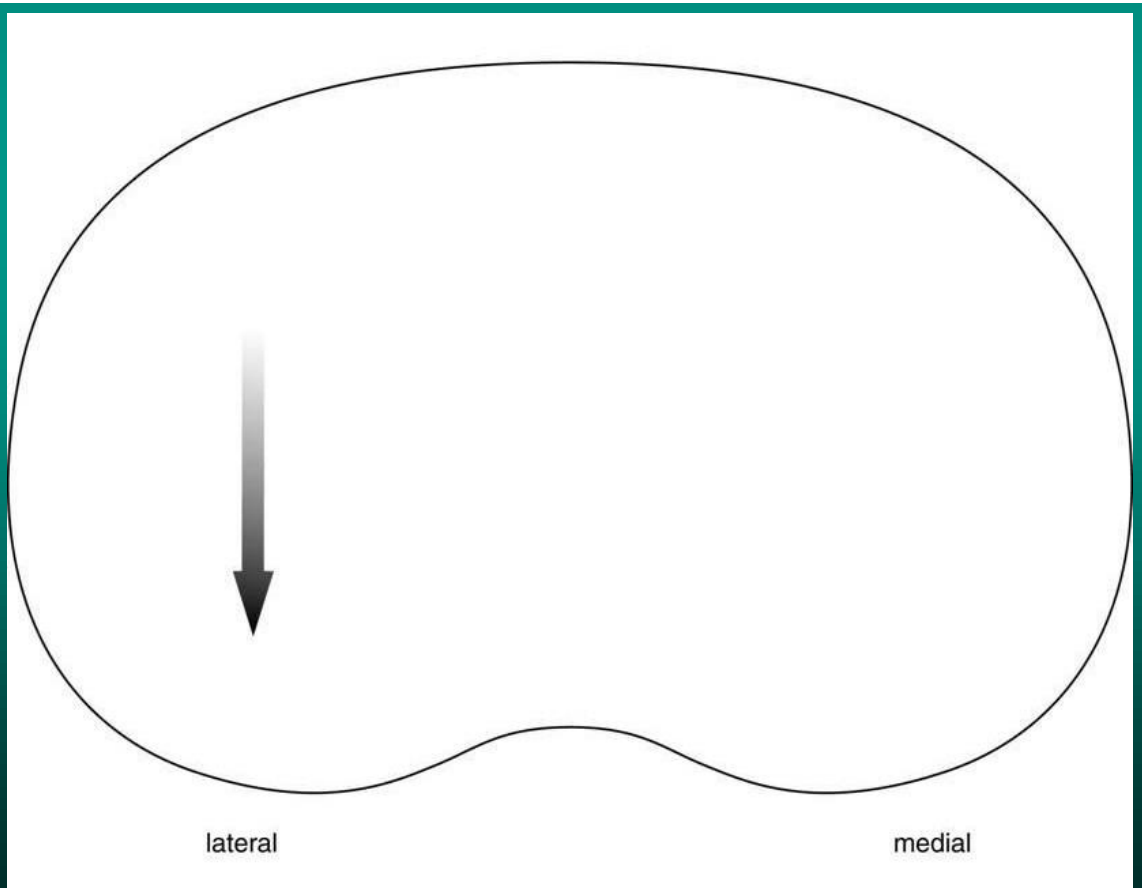
- Indicated for knees without deformity
- More normal kinematics
- Long term durability not established

Asymmetric Insert

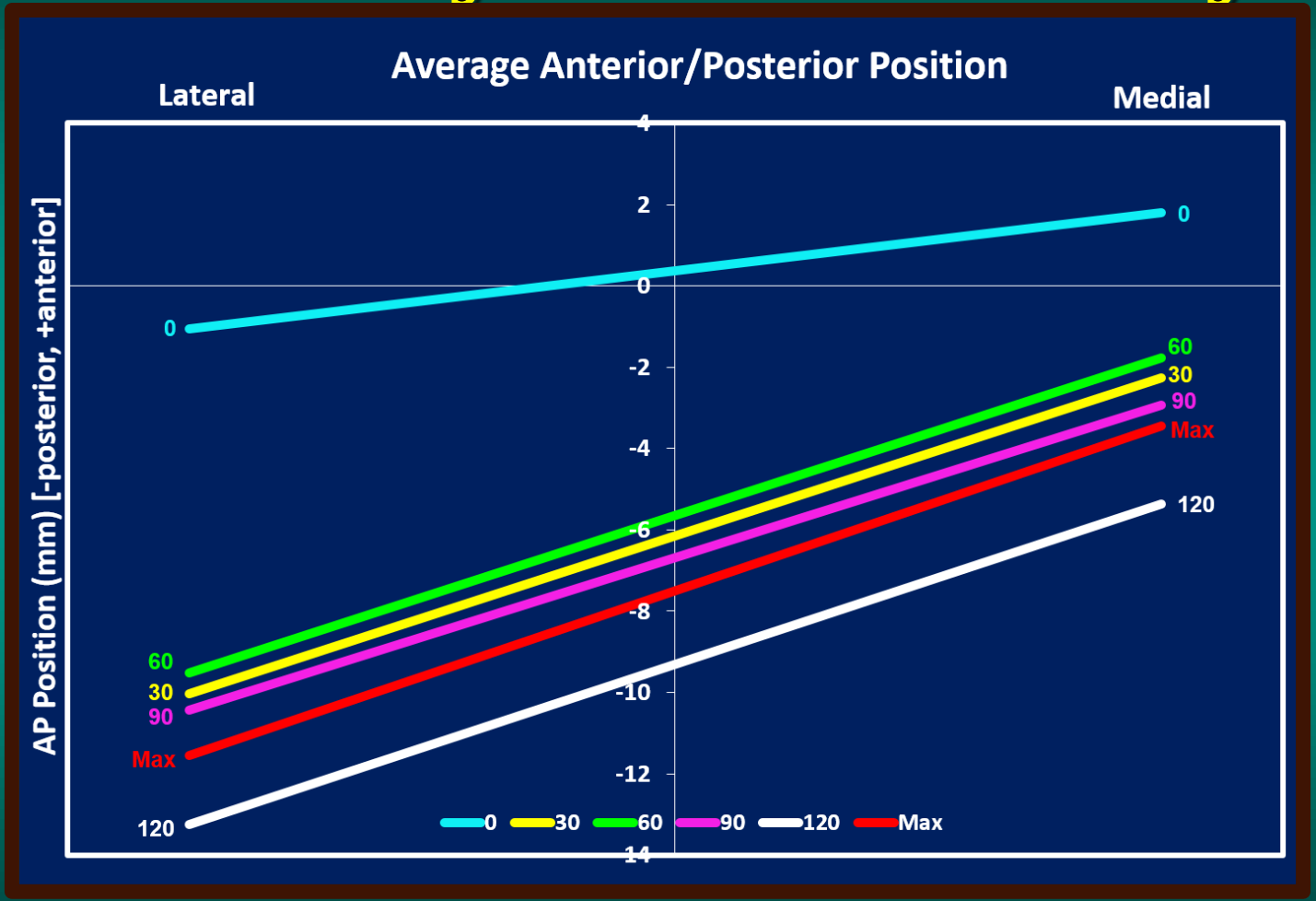


Sloped lateral plateau

Concave medial plateau



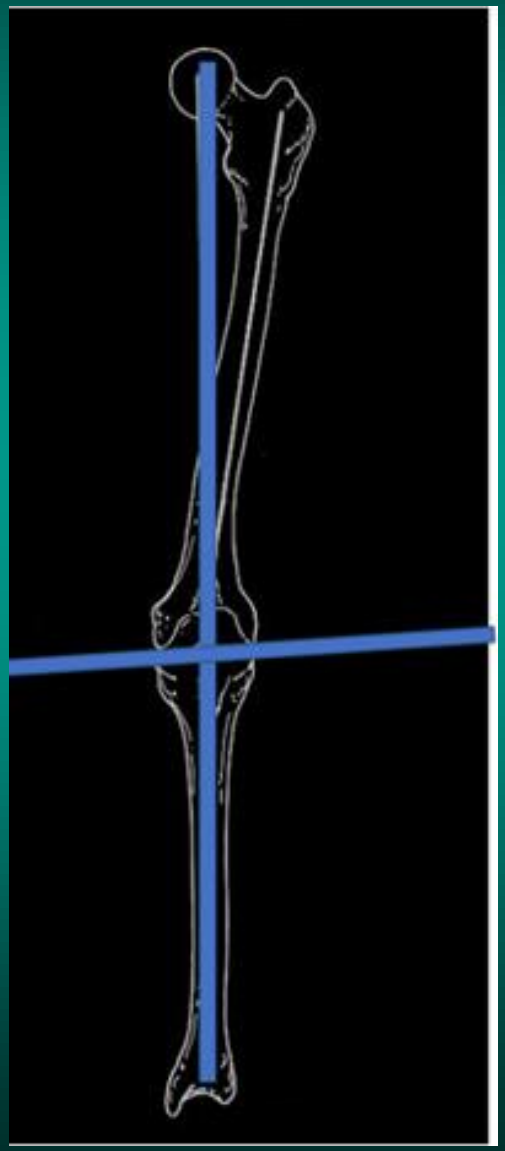
Journey II: DKB Early

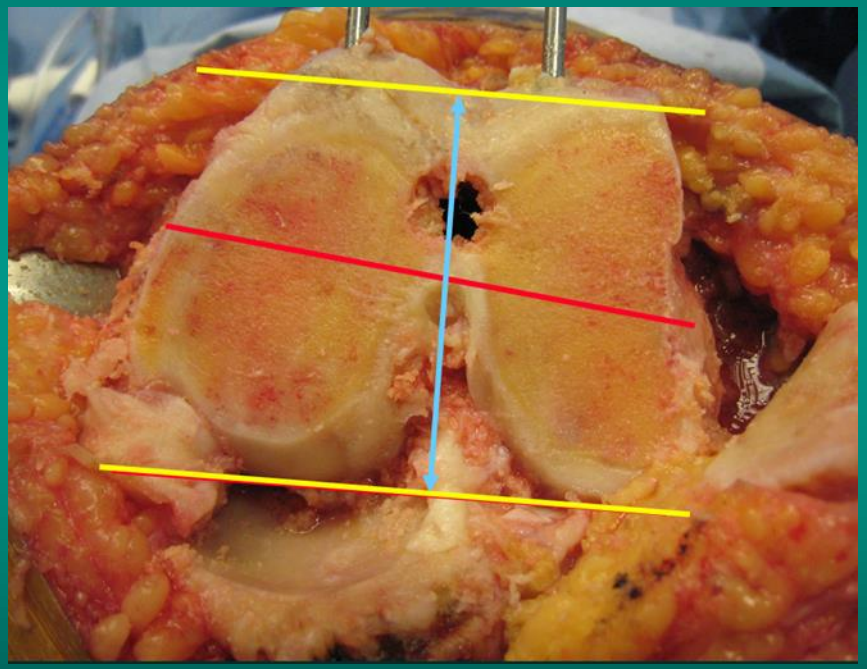


Kaneko T, Kono N, Mochizuki Y, Hada M, Toyoda S, Musha Y. Bi-cruciate substituting total knee arthroplasty improved medio-lateral instability in mid-flexion range. J Orthop 2017

- 33 Journey 2 patients
- Gaps after implantation from extension to full flexion with reduced patella by constant distraction force of 120N
- Varus ligament balance gap defined by subtracting from lateral to medial component gap.
- Varus ligament balance gap was negatively corrected with postoperative Knee society score (patient's satisfaction) ($r = 0.661$, $p = 0.001$).
- The most important findings of the present study are that BCS TKA can reduces the ML instability in mid-flexion range, and improve satisfaction.

Kinematic Alignment





Gao ZX, Long NJ, Zhang SY, Yu W, Dai YX, Xiao C. Comparison of Kinematic Alignment and Mechanical Alignment in Total Knee Arthroplasty: A Meta-analysis of Randomized Controlled Clinical Trials Orthop Surg, 12:1567-1578. 2020.

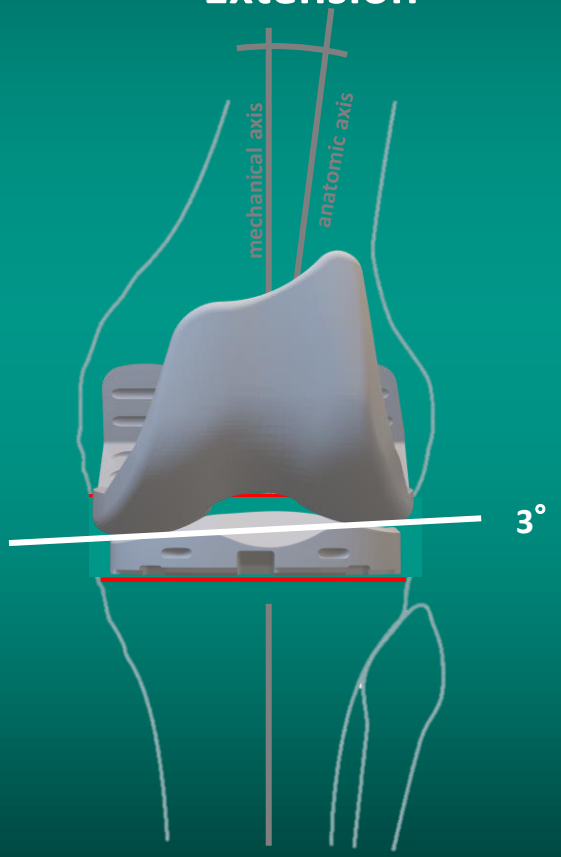
11 randomized controlled trial studies

More ligament release in MA-TKA than KA-TKA

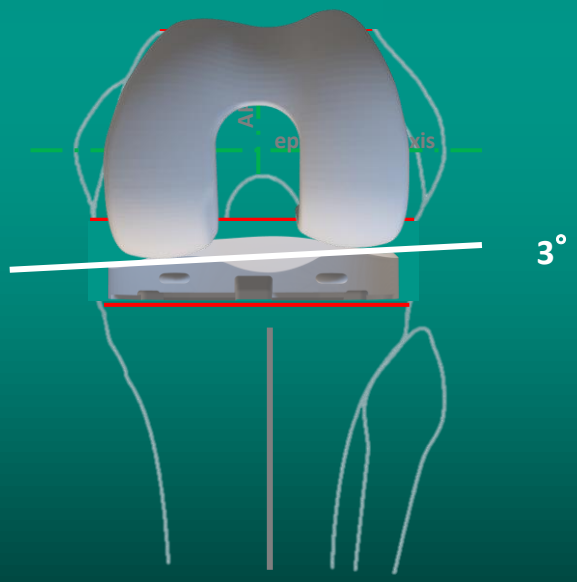
This meta-analysis shows that the KA-TKA had better clinical outcomes and knee range of flexion than MA-TKA group at short-term follow-up.

Kinematic Alignment

Extension



Flexion



Batailler C, Fernandez A, Swan J, Servien E, Haddad FS, Catani F, Lustig SMAKO CT-based robotic arm-assisted system is a reliable procedure for total knee arthroplasty: a systematic review. Knee Surg Sports Trauma Arthr 2021

- **26 studies**
- **Equal or slightly superior improvement of the functional outcomes with robotic TKA**

Role of Knee implant Technology in Personalizing Medicine – Should One implant Fit All?

- Probably not (my opinion)
- Use implant and technique for best ligament balance and stability
- Use fixation method based on BMI and bone quality

Thank You