Masterclass

Tips and tricks for a successful outcome

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Ultimate Goal of TKR

- Normal alignment
- Ligament balance: equal flexion and extension gaps

- Interface overload with consequent aseptic loosening
- PE overload with accelerated wear
- Ligament overload: pain +/- limited motion
- Instability

	X-axis	Y-axis	Z-axis
Malalignment **around** axis	flexion/ extension	internal/external rotation	varus/valgus
Malalignment **along** axis	medial/lateral translation	proximal/distal displacement	anterior/ posterior displacement

Reference Axes

Natural/Neutral Mechanical Alignment

Whiteside‘s Line

Trans-Epicondylar Axis (s/a)

Trans-Cylindrical Axis

Posterior Condylar Line (PCL)

Medial Border Tibial Tubercle

Functional Flexion Axis (FFA)

Joint Line

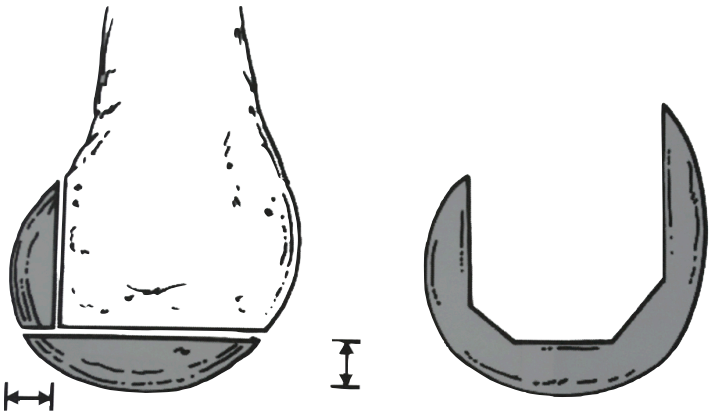
Tibial Slope

Surgical Philosophies

- Measured Resection
- Gap Balancing – Flexion first/Extension first

Measured Resection

- Resected amount of the distal + posterior femur = thickness prosthetic component
  - articular surface of the replaced knee = same level of the natural knee
  - kinematics: identical to those of the normal knee



- BUT :
  osteoarthritic knee ≠ normal knee

Measured Resection

- Bony references:
  - Trans-Epicondylar Axis (TEA)
  - Posterior Condylar Line (3° ER off the post. cond.)
  - Whiteside‘s Line

➔ TEA: best surgical approximation of the true morphological flexion/extension axis, around which the implant should be positioned

➔ bony references: intra-operative identification is often not accurate!

Measured Resection

- Adapted Measured Resection
  - native PCA (posterior condylar angle) = angle between sTEA and PCL (CT scan)
    (Luyckx et al., J.B.J.S Br., 2012)

Gap Balancing (Tensioned Gap Technique)

- Flexion first/Extension first
- Flexion/Extension axis = functional (FFA)
  - replaced knee ≠ normal knee
  - dictated by soft tissue envelope
- FFA: lowest variability/less surgical dependent

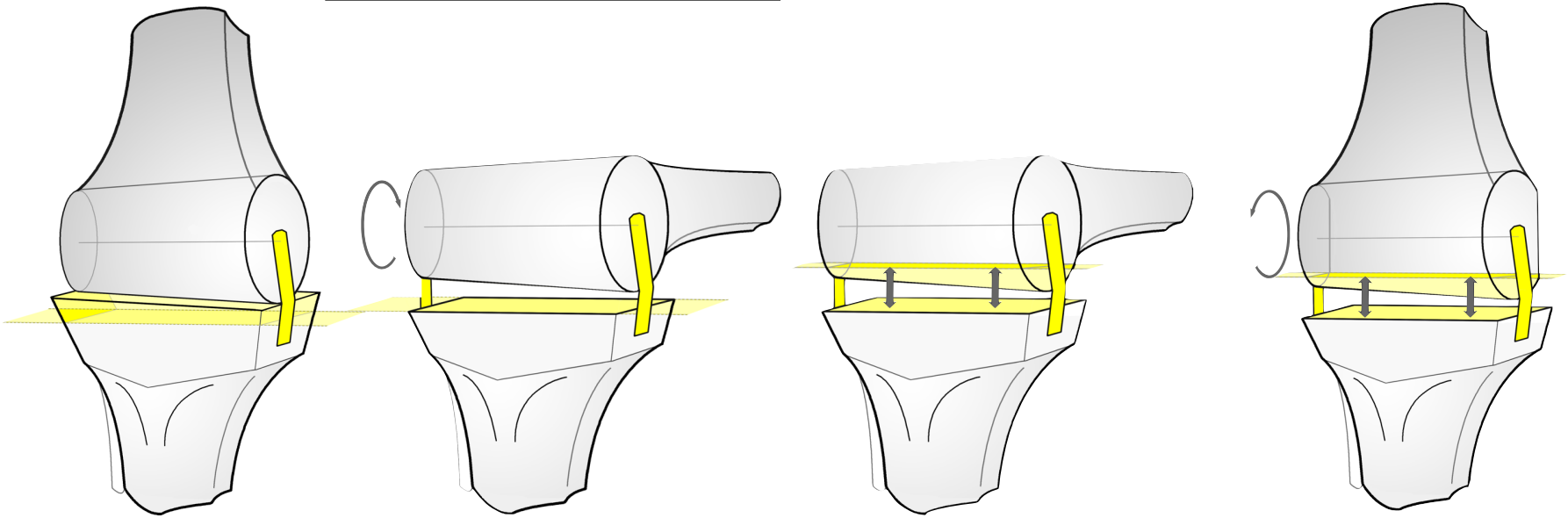
Gap Balancing: Flexion First

I. proximal cut on the tibia

II. 90° flexion : resection based on tension in collateral ligaments
- spacer/balancer/ tensiometer

III. posterior cut on the femur
- referenced off of tibial cut
- rectangular flexion gap

IV. resection distal femur
- rectangular extension gap
- equal F/E gaps



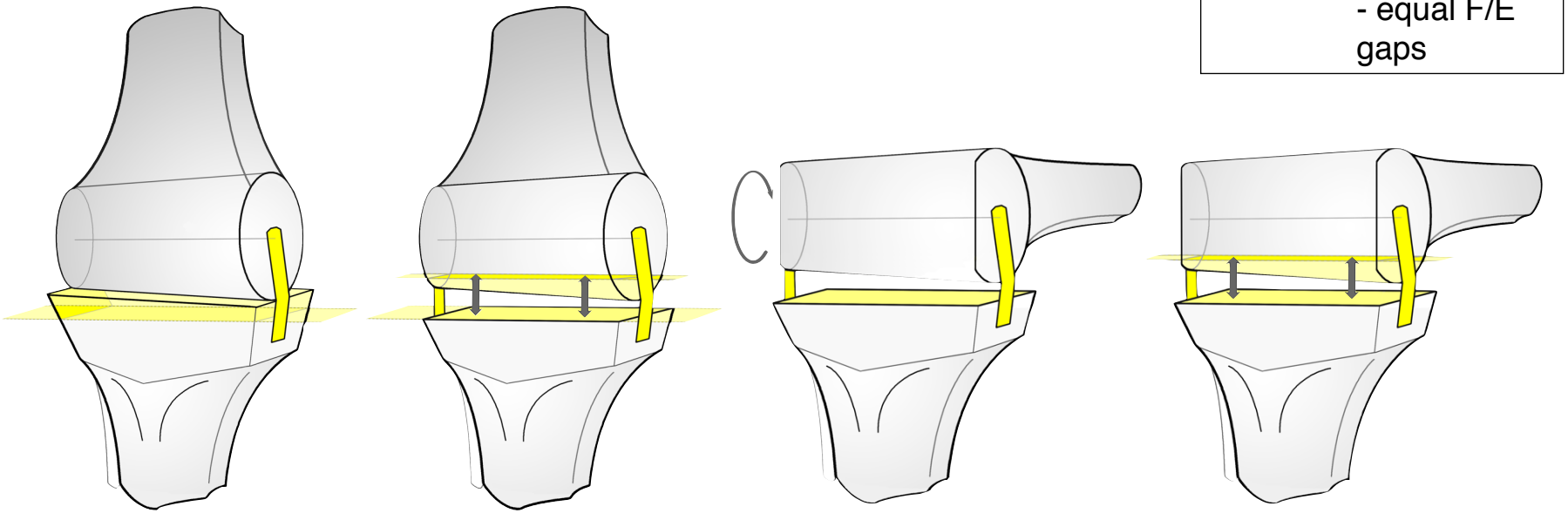
Gap Balancing: Extension First

I. proximal cut on the tibia

II. measured resection in extension
- rectangular extension gap

III. 90° flexion: resection based on tension in collateral ligaments
- spacer/balancer

IV. posterior cut on the femur:
- referenced off of tibial cut
- rectangular flexion gap
- equal F/E gaps



Gap Balancing (Tensioned Gap Technique)

- BEWARE: natural laxity of the lateral side of the knee
  - increased external rotation femoral component
  - increased varus alignment at 90° of flexion

Kinematic Alignment

- Bony operation: bone cuts around transcylindrical axis
- No or few soft tissue releases
- Patient Match Technology

Tibial Resection

- Extramedullary (bowing)
- Perpendicular to the tibial intramedullary canal axis
- Resection level:
  - 10 mm, referencing off the deepest portion of the **unaffected** tibial condyle
  - 2-4 mm, referencing off the **most affected** tibial

Tibial Resection

- BEWARE:
  - Varus knee:
    - minimal bone loss medially
    - resection 2 mm below medial tibial surface
    - raise the joint line by 8 mm for a 10 mm tibial component thickness (early-flexion instability 30-60°)
  - Valgus knee:
    - less bone resection than usual
    - 6-8 mm from the more intact side (medial side)
  - PCL-resection:
    - can open the flexion space with 4 mm

Tibial Resection

- Tibial slope:
  - ROCC: NO slope: PE bearing has integrated 7° slope
  - opens flexion space
  - avoid excessive down-sloping
    - anterior instability
    - PCL injury
    - mid-flexion instability (90°)
  - tibial slope should not exceed 7° (CR)

Posterior Clearance

- Removal of femoral osteophytes to relieve tension on the posterior capsule
  - before cut distal femur
  - if done after cut distal femur: modification of the extension gap (hyperextension)

Distal Femoral Resection

- 5° of anatomic VL
- BEWARE: natural alignment/neutral mechanical alignment
  - constitutional varus knees
  - 32% ♂/17% ♀ ≥ 3° VR at the end of skeletal maturity
  - aim for slight VR of 2°

Distal Femoral Resection

- Practically:
  - extramedullary guide tibia: neutral
  - intramedullary guide femur:
    - VARUS knee: 4° VL (instead 5° VL)
    - VALGUS knee: 6° VL (instead 5° VL)
- Resection level:
  - 9 mm from the most distal condyle (= distal thickness of the final implant)
  - 7 mm in case of severe abrasion

Extension Gap

- Extension Spacer:
  - equal medial and lateral balance
  - full extension

➔ No full extension: recut ≥ 2mm

➔ Imbalance in extension: correct the VL angle
(1° VL = 1 mm bone resection)

Femoral Component Rotation

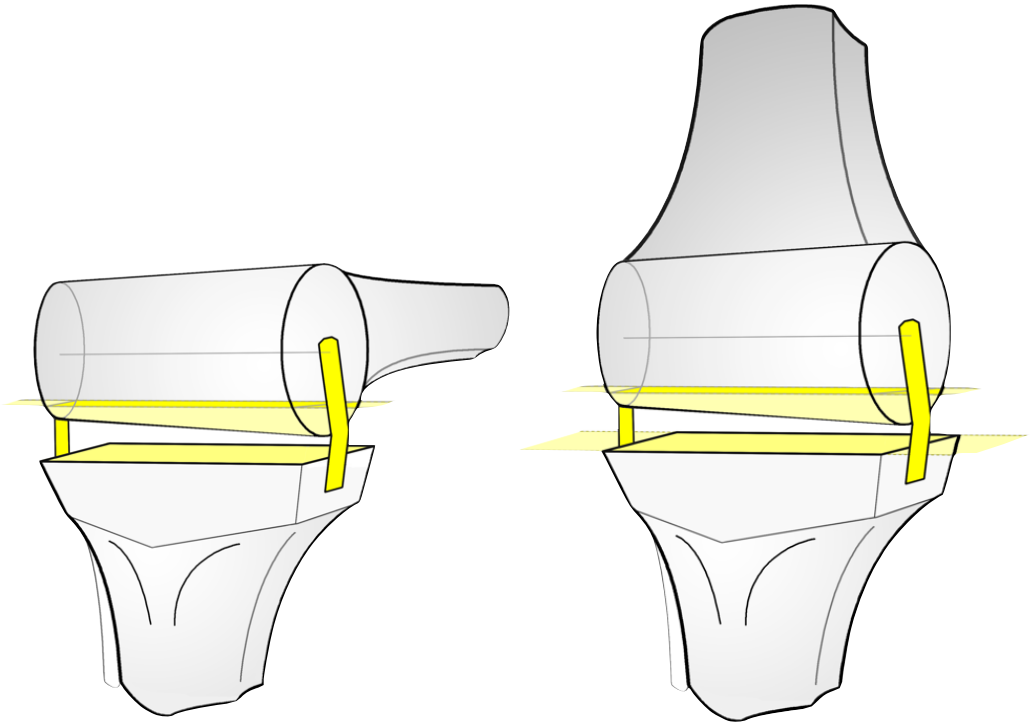
- Gap Balancing vs. Measured
  - femoral component rotation: equally reliable and accurate in both groups
  - more external rotation in gap balancing group (NS)
    (Luyckx et al., J.B.J.S Br., 2012)

Femoral Component Rotation

- Gap Balancing vs. Measured
  - computer-assisted gap balancing technique: more precise soft tissue balance and restoration of limb alignment, better knee scores
    (Pang et al., K.S.S.T.A., 2011)
  - measured resection: slight superiority in preserving the preoperative joint line (NS)
    (Tigani et al., K.S.S.T.A., 2010)

Femoral Component Rotation

- Gap Balancing: Flexion/Extension first

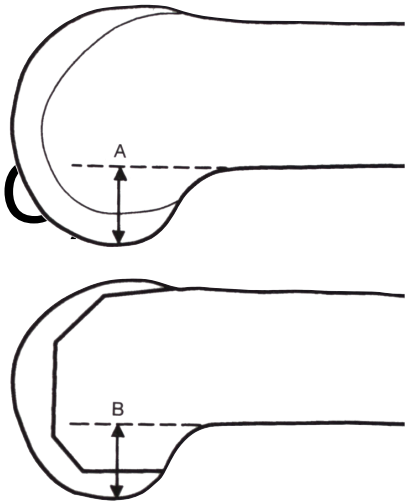


Intramedullary Ligament

- single force applied to the knee joint
- distraction of the joint till collateral ligaments stay balanced
- simple
- fast
- cheap
- reproducible
- non-surgeon dependent:
  same rotation for everyone

Femoral Sizing

- Anterior referencing
- Posterior Condylar Offset (PCO)
  - to maintain PCO: large amount of femoral sizes to avoid anterior overstuffing
  - Vanguard ROCC: 9 sizes with 2.3 mm increments, keeping the same PCO

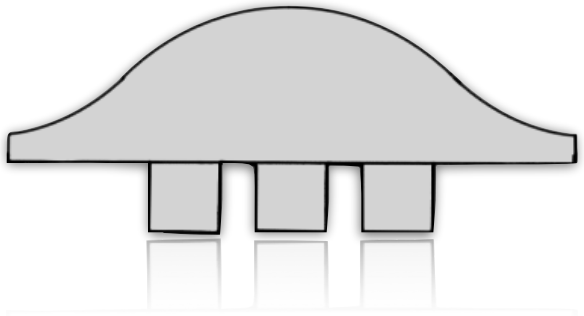


Femoral Sizing

- Reduction PCO:
  - loose flexion space/unaffected extension space
    - early- and mid-flexion instability
  - slackens the PCL
    - paradoxical roll-forward
  - early impingement/reduced flexion

Patella

- ROCC: modified dome shaped patella (sombrero hat)
  - convex with a concave surface near the circumference
  - wear simulator: ⇧20x life-expectancy compared to standard dome component

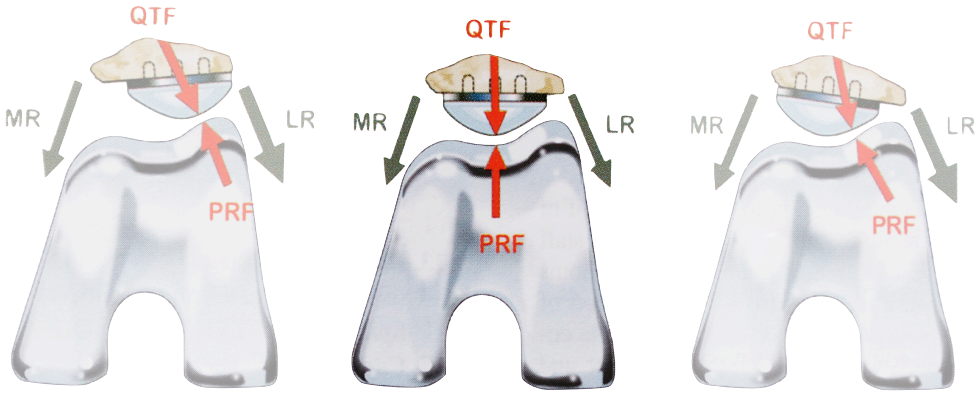


Patellar Maltracking

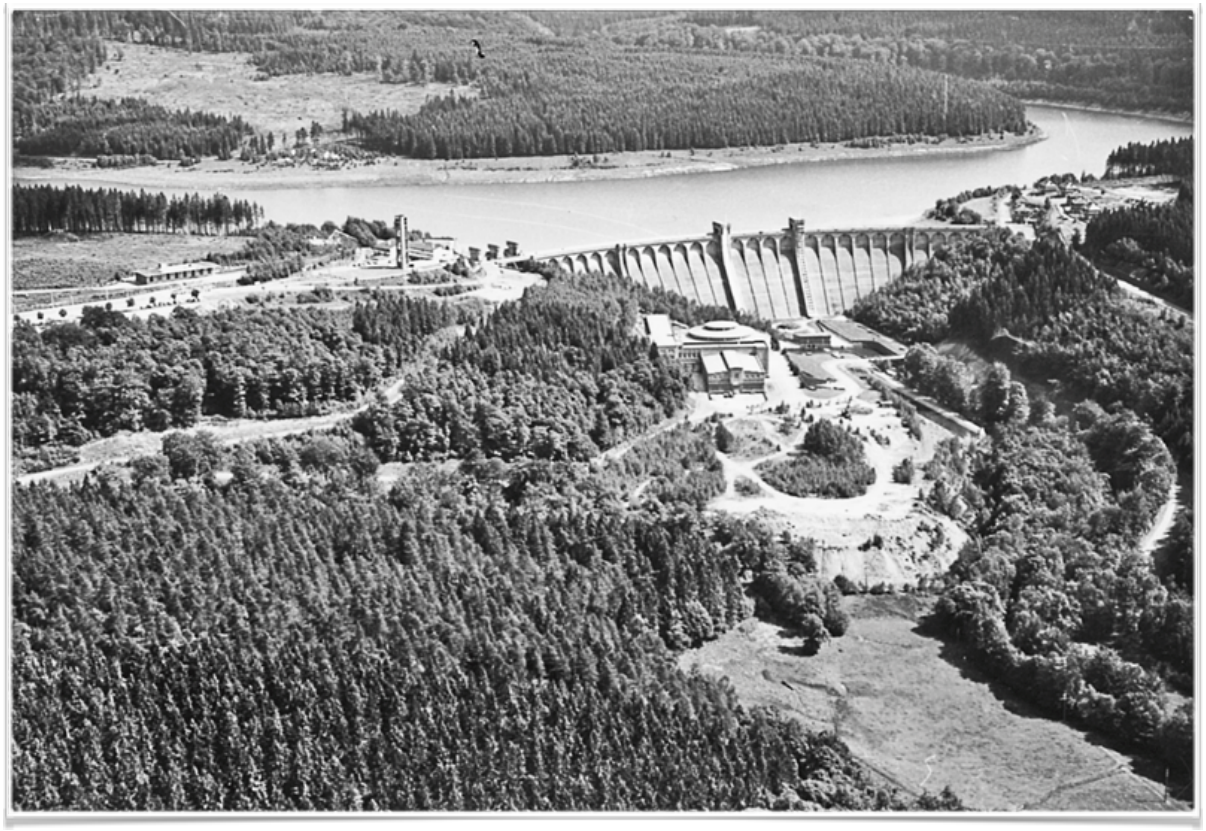
- Patellar component malalignment
  - under-resection of the patella/overstuffing
  - lateralisation
  - overzealous medialisation
- Femoral/tibial component malalignment
  - internal rotation
  - medialisation
  - valgus
- Anterior displacement/femoral component oversizing

Patellar Maltracking

- Tips:
  - moderate medialisation
  - avoid overstuffing
    - normal knee: squeezing of the cartilage in deep flexion *(H. Vandenneucker, ESSKA, 2012)*
    - anatomical trochlea: patellofemoral joint at original depth
  - leave ≥ 10 mm bone



Thank you for your attention!



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