UPDATE IN JOINT REPLACEMENT SURGERY—WHAT’S NEW?

Dr. Lee Quinn Jid
Associate Consultant
Deputy Director Total Joint Replacement Center,
Yan Chai Hospital
TOTAL KNEE REPLACEMENT
Update in Total Knee Replacement

• New Techniques
  • Kinematic alignment
  • Soft tissue balance
  • Robotic TKR

• New Implants
  • Medial pivot/ ultracongruent TKR
  • Cementless Tibial Monoblock
  • Bicruciate stabilized/ retaining TKR

• New perioperative management
  • Pain management
  • Blood management
  • Same-day / out-patient surgery

• New Outcome Measures
  • Forgotten Joint Score
TKR alignment

Conventional alignment:
- Neutral limb and component mechanical axis (Insall)
- Coronal alignment (1 axis)
- X-ray AP film (2D)
- Even stress distribution
- Ensure long term survivorship
TKR alignment

- **Mechanical alignment: Drawbacks**
  - Obliquity of joint line
  - Neglect constitutional varus (Bellemans):
    - Produce collateral ligament imbalance
    - Soft tissue release obligatory
  - Elevation of joint line (thicker insert)
  - Retinaculum imbalance
    - Requires compensatory axial rotation of femoral component

- **Anatomic alignment (Hungerford)**
  - Neutral limb alignment
  - Component alignment:
    - 3’ varus tibia, 9’ valgus femoral
    - Horizontal joint line
  - Problem: Increase tibial medial load
TKR alignment

• What’s new?
  • Kinematic alignment (Howell)
    • Patient specific “original alignment”
      • 0° HKA angle
        • 2% normal subjects
      • “Constitutional varus” (Bellemans)
        • F 17% M 32%
    • 3D alignment (3 axes)
    • MRI assessment
    • Computerized reconstruction of pre-diseased knee
      • “Joint-resurfacing”
        • No joint line elevation
        • Minimal soft tissue release
    • Ensure good kinematics and function
TKR alignment

- **Kinematically aligned TKR**
  - **Outcome:**
    - More normal gait pattern
    - Better functional scores in short term
    - Comparable short-term survivorship
    - No difference in complications
  - **Potential problems:**
    - Joint line slanting (severe deformity)
      - Indication restricted to milder deformities
    - Patellar tracking
  - **Modifications:**
    - “Restricted Kinematic alignment”
      - Aim: Component alignment ≤ ± 5°; HKA ≤ ±3°;
    - “Adjusted mechanical alignment”
      - Slight under-correction of femoral deformity

TKR alignment options

Fig. 2. Different philosophies for implanting a TKA. To illustrate this classification, a knee with severe constitutional varus deformity has been selected. MA: Mechanical Alignment technique; AA: Anatomical Alignment technique; aMA: adjusted Mechanical Alignment technique; rKA: restricted Kinematic Alignment technique. UKA: Unicompartmental Knee Arthroplasty.

## TKR alignment: algorithm approach

<table>
<thead>
<tr>
<th>Knee types</th>
<th>1</th>
<th>2</th>
<th>3a</th>
<th>3b</th>
<th>3c</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity of procedure</td>
<td>Simple</td>
<td>Complex</td>
<td></td>
<td></td>
<td></td>
<td>History of non traumatic patella instability</td>
</tr>
<tr>
<td>Description</td>
<td>After correction of articular wear there is no severe frontal pathoanatomy</td>
<td>After correction of articular wear there is a severe (constitutional or post-traumatic) frontal pathoanatomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HKA after correction of articular wear</td>
<td>≤ 5° varus or valgus</td>
<td>&gt;5° varus with “tibia valgus” present</td>
<td>&gt;5° valgus without “tibia valgus”</td>
<td>Valgus knee with severe MCL distension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possible alternative techniques for TKA</td>
<td>KA</td>
<td>rKA with tibial adjustment or “KA + realignment osteotomy” (KA ?)</td>
<td>rKA with tibial and femoral adjustment or “KA + realignment osteotomy” (prevent excessive joint line obliquity)</td>
<td>Not indicated</td>
<td>“KA + MPFL reconstruction” +/- lateral retinaculum release and VMO plasty +/- extensor mechanism realignment</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 5.** Algorithm for use of more anatomical surgical techniques for total knee arthroplasty. Alternative techniques of implant positioning are suggested and additional procedure(s) (osteotomy, ligament reconstruction, and so on) are recommended depending on the type of pathoanatomy, KA: Kinematic Alignment technique; rKA: restricted Kinematic Alignment technique; MCL: Medial Collateral Ligament; MPFL: Medial Patello-Femoral Ligament; VMO: Vast Medial Oblique.

Computer Navigated TKR

- **Current evidence:**
  - Minimize outliers in coronal alignment (<3°) and femoral component rotation
  - Portable navigation systems (accelerometer-based)
    - accurate without significantly increasing surgical time
    - Range of motion, clinical scores, or long-term survivorship same
  - Higher cost

- **What’s new?**
  - Role more important with non-mechanical alignment?
  - Essential part of robotic surgery

Robotics TKR/UKR

- **Potential advantages**
  - Greater component accuracy and precision
  - Less iatrogenic bone & soft-tissue injury
  - Increased patient satisfaction
  - Less surgeons fatigue
  - Kinematic TKR

- **Cost-benefits?**
- **Long term benefits?**

Soft tissue balance

• **Conventional balance:**
  • Medial = Lateral laxity
  • Flexion = Extension
  • Aim: Equal rectangular gaps

• **Conventional debate:**
  • Gap-technique (soft tissue tension) vs
  • Measured resection (bony landmark) technique

Soft tissue balance

• What’s new?
  • Lateral soft tissue more lax naturally
    • Perfect balance by “Gap technique” create more femoral ER
      • Altered knee kinematic /patellar tracking
  • New target: equal trapezoidal gaps in flexion and extension

• MCL not shortened in varus deformity
  • Conservative medial release

Conventional gap-technique

Modified gap-technique
TKR kinematic

- Conventional TKR problem:
  - 10-20% dissatisfaction
  - Physiological roll-back not achieved
  - No ACL
    - Paradoxical anterior gliding of femur during flexion occur in both CR / PS design

- PCL:
  - Retention:
    - Kinematic conflict
  - Sacrificed/ Stabilized:
    - Mid-flexion instability (30-60’)

EXTENDED KNEE

BENT KNEE
Medial Pivot/ ultracongruent TKR

• Old concept (Since 1998) New interest

• Design concepts
  • Ultra-congruent tibial insert (medial side)
    • Medial meniscus socket
      • ACL-PCL substituting
        • Anterior lip: PCL
        • Posterior lip: ACL
    • Lateral meniscus path
      • Lower conformity/constrain
      • 15’ of motion
Medial Pivot TKR: long term outcome

- Survivorship
  - Meta-analysis
    - 99.2% at 5 years
    - 97.6% at 8 years
  - Cohort
    - 98.8% survivorship at 17 years.

**Objectives**
This systematic review and meta-analysis was conducted to determine the mid- to long-term clinical outcomes for a medial-pivot total knee replacement (TKR) system. The objectives were to synthesise available survivorship, Knee Society Scores (KSS), and reasons for revision for this system.

**Methods**
A systematic search was conducted of two online databases to identify sources of survivorship, KSS, and reasons for revision. Survivorship results were compared with values in the National Joint Registry of England, Wales, and Northern Ireland (NJR).

**Results**
A total of eight studies that included data for 1146 TKRs performed in six countries satisfied the inclusion/exclusion criteria. Pooled component survivorship estimates were 99.2% (95% CI, 97.7 to 99.7) and 97.6% (95% CI, 95.8 to 98.6) at five and eight years, respectively. Survivorship was similar or better when compared with rates reported for all cemented TKRs combined in the NJR and was significantly better than some insert types at mid-term intervals. The weighted mean post-operative KSS was 87.9 (73.2 to 94.2), in the excellent range. Similar cumulative revision rates and KSS were reported at centres in the United States, Europe, and Asia.

**Conclusions**
The subject system was associated with survivorship and KSS similar or better than that reported for other TKR systems.

Cite this article: Bone Joint Res 2014;3:297–304
Bicruciate retaining TKR

- Cadaveric studies:
  - AP stability better
  - Rotational stability similar

- Recent clinical studies:
  - Long term survival comparable
  - Better proprioception
  - Better patient satisfaction

Bicruciate substituting TKR

- In vivo kinematic studies:
  - More similar to normal knees
- RCT (BCR vs PS):
  - No difference in short term outcome

Cementless Tibial Monoblock

• Increasing demand:
  • More patients with younger age/ higher activity level

• **Whats’ New?**
  • Porous tantalum for tissue ingrowth

• Metaanalysis:
  • Fewer radiolucent lines, and shorter operation.
  • No significant difference in total complications, reoperation and loosening

• Long term retrospective studies:
  • Age < 60 yr or > 60 yr
  • No loosening at 10 years

Pain management

• What’s New?

1. Multimodal protocol:
   • New drugs:
     • IV acetaminophen
     • costs and the short-term effects noticeable
     • Cox2-inhibitor
     • Opioid sparing, reduced the occurrence of delirium in elderly
     • IV corticosteroid
     • Reduce LOS, pain, nausea
     • Reduce IL-6
   • Gabapentinoids
     • no increased efficacy
Pain Management

• What’s New?

2. Local Infiltrative Analgesia (LIA)
   - Ketorolac + local anesthetic (Ropivacaine/bupivacaine) + adrenaline
   - Pain relief 24-72 hours
   - No difference with regional block
   - Superiority of liposomal bupivacaine?
   - No additional benefits of local morphine
   - Corticosteroid
     - Reduce pain
     - Risk of infection?
   - Preferential injections into the anterior compartment better?


Blood Management

• What’s new
  • Key component of fast-track TJR
  • PBM guidelines:
    • Australia:
      • Patient Blood Management Guidelines Module 2 (National Blood Authority) 2012
    • UK:
      • AAGBI guidelines 2016
    • HK:
      • HA Perioperative Blood Management Guidelines 2017
Blood Management

Pre-op
- Anemia screening & treatment
- Blood ordering schedule
- Antiplatelet/NSAID/anticoagulant regimen
- Autologous blood donation

Intra-op
- Antifibrinolytic agents (TXA)
  - Bone plug, navigation
  - Cell saver
  - Topical fibrin sealants

Post-op
- Compression bandage
- Drain protocol
- Transfusion trigger
- Drainage retransfusion

Patient Blood Management (PMB)
Blood management

- What’s new?
  - Tranexamic acid (TXA)
    - Markedly decreased the transfusion rate in THR/TKR
  - Optimal route (IV, IA, PO) undefined
  - No increase in VTE

Blood Management

2013-17 HA Transfusion rate of TKR

- Transfusion rate (%)

Acknowledgement: Dr. Chan Ping Keung
Outpatient Surgery

- Up to 15% cases eligible
- Higher rate of medical complications
  - Bleeding requiring transfusion
- Higher readmission rate
- Cost-benefits calculation required
- Common barriers:
  - Afternoon cases, inadequate pain control, and failure to mobilize safely

New Outcome Measure

- **Patient Report Outcome Measure (PROM)**
  - Increasing importance
  - Part of registry data (Swedish Joint Registry)
  - E.g. EQ-5D, Satisfaction Score
  - Drive for research for better TKR

**EQ-5D**

- **MOBILITY**
  - I have no problems with walking about
  - I have some problems with walking about
  - I am confined to bed

- **SELF-CARE**
  - I have no problems with self-care
  - I have some problems with self-care
  - I am unable to wash or dress myself

- **USUAL ACTIVITIES (e.g., work, study, housework, family or leisure activities)**
  - I have no problems with performing my usual activities
  - I have some problems with performing my usual activities
  - I am unable to perform my usual activities

- **PAIN/COMFORT**
  - I have no pain or discomfort
  - I have moderate pain or discomfort
  - I have extreme pain or discomfort

- **ANXIETY/DEPRESSION**
  - I am not anxious or depressed
  - I am slightly anxious or depressed
  - I am extremely anxious or depressed
New Outcome Measure

What's new?

- **Forgotten Joint Score**
  - 12 questions ADL and recreation
  - Replaced joint “forgotten”
  - Less ceiling effect
  - More sensitive to good outcome
  - Detect subtle differences
  - Validated in different languages
    - Cantonese (YCH)
The 2018 Definition of Periprosthetic Hip and Knee Infection: An Evidence-Based and Validated Criteria

Javad Parvizi, MD a,*, Timothy L. Tan, MD a, Karan Goswami, MD a, Carlos Higuera, MD b, Craig Della Valle, MD c, Antonia F. Chen, MD, MBA a, Noam Shohat, MD a, d

Performance of the New Definition Compare With the Traditionally Used Musculoskeletal Infection Society (MSIS) and International Consensus Meeting (ICM) Criteria.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>PJI Cohort (n = 222)</th>
<th>Aseptic Cohort (n = 200)</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>True Positives</td>
<td>False Negatives</td>
<td>Inconclusive</td>
<td>True Negative</td>
</tr>
<tr>
<td>MSIS (2011)</td>
<td>176 (79.3%)</td>
<td>46 (20.7%)</td>
<td>-</td>
<td>199 (99.9%)</td>
</tr>
<tr>
<td>ICM (2013)</td>
<td>193 (86.9%)</td>
<td>29 (13.1%)</td>
<td>-</td>
<td>199 (99.9%)</td>
</tr>
<tr>
<td>New definition (2018)</td>
<td>212 (95.5%)</td>
<td>5 (2.3%)</td>
<td>5 (2.3%)</td>
<td>195 (97.5%)</td>
</tr>
</tbody>
</table>

CI, confidence interval; PJI, periprosthetic joint infection.
Periprosthetic Joint Infection

<table>
<thead>
<tr>
<th>Major criteria (at least one of the following)</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two positive cultures of the same organism</td>
<td></td>
</tr>
<tr>
<td>Sinus tract with evidence of communication to the joint or visualization of the prosthesis</td>
<td>Infected</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preoperative Diagnosis</th>
<th>Score</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevated CRP or D-Dimer</td>
<td>2</td>
<td>≥6 Infected</td>
</tr>
<tr>
<td>Elevated ESR</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Synovial</td>
<td></td>
<td>2-5 Possibly Infected (^a)</td>
</tr>
<tr>
<td>Elevated synovial WBC count or LE</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Positive alpha-defensin</td>
<td>3</td>
<td>0-1 Not Infected</td>
</tr>
<tr>
<td>Elevated synovial PMN (%)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Elevated synovial CRP</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Inconclusive pre-op score or dry tap \(^a\)

<table>
<thead>
<tr>
<th>Intraoperative Diagnosis</th>
<th>Score</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative score</td>
<td>-</td>
<td>≥6 Infected</td>
</tr>
<tr>
<td>Positive histology</td>
<td>3</td>
<td>4-5 Inconclusive (^b)</td>
</tr>
<tr>
<td>Positive purulence</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Single positive culture</td>
<td>2</td>
<td>≤3 Not Infected</td>
</tr>
</tbody>
</table>

\(^a\) Refer to specific criteria for each parameter.

\(^b\) Inconclusive criterion based on clinical judgment.
Periprosthetic Joint Infection

<table>
<thead>
<tr>
<th>Marker</th>
<th>Chronic (&gt;90 d)</th>
<th>Acute (&lt;90 d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum CRP (mg/dL)</td>
<td>1.0</td>
<td>10</td>
</tr>
<tr>
<td>Serum D-dimer (ng/mL)</td>
<td>860</td>
<td>860&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Serum ESR (mm/h)</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Synovial WBC count (cells/μL)</td>
<td>3000</td>
<td>10,000</td>
</tr>
<tr>
<td>Synovial PMN (%)</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>Synovial CRP (mg/L)</td>
<td>6.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.9</td>
</tr>
<tr>
<td>Synovial alpha-defensin (signal-to-cutoff ratio)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; ICM, International Consensus Meeting; PMN, polymorphonuclear; WBC, white blood cell.

<sup>a</sup> Further studies are needed to validate a specific threshold.
What’s New: Summary

- Better replication of normal joint kinematics
- More precise bone cuts/ reaming
- Better perioperative care
- Less transfusion
- Faster recovery
- More sensitive outcome measure
- More accurate detection of infection
- Improved longevity
References


WHAT'S THE DIFFERENCE BETWEEN THESE TWO OLD MEN?

The Youth of today... Sigh!

Get with it, daddy!

Fred has had a hip replacement.