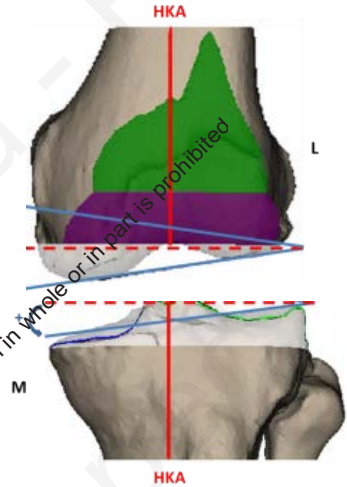


Restricted Kinematic Alignment : the Ideal Compromise



Pascal-André Vendittoli MD, MSc, FRCS

Professor of Surgery
Senior FRSQ researcher
ERAS Ortho Chair Leader Canada
Past President of the Personalized Arthroplasty Society



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Why proposing a “Restricted” KA ?

In this Paradigm Change from Systematic to Personalized Surgery

2 questions remain:

- What is normal lower limb anatomy?
- What anatomical parameters are compatible with the current implant material and fixation methods?

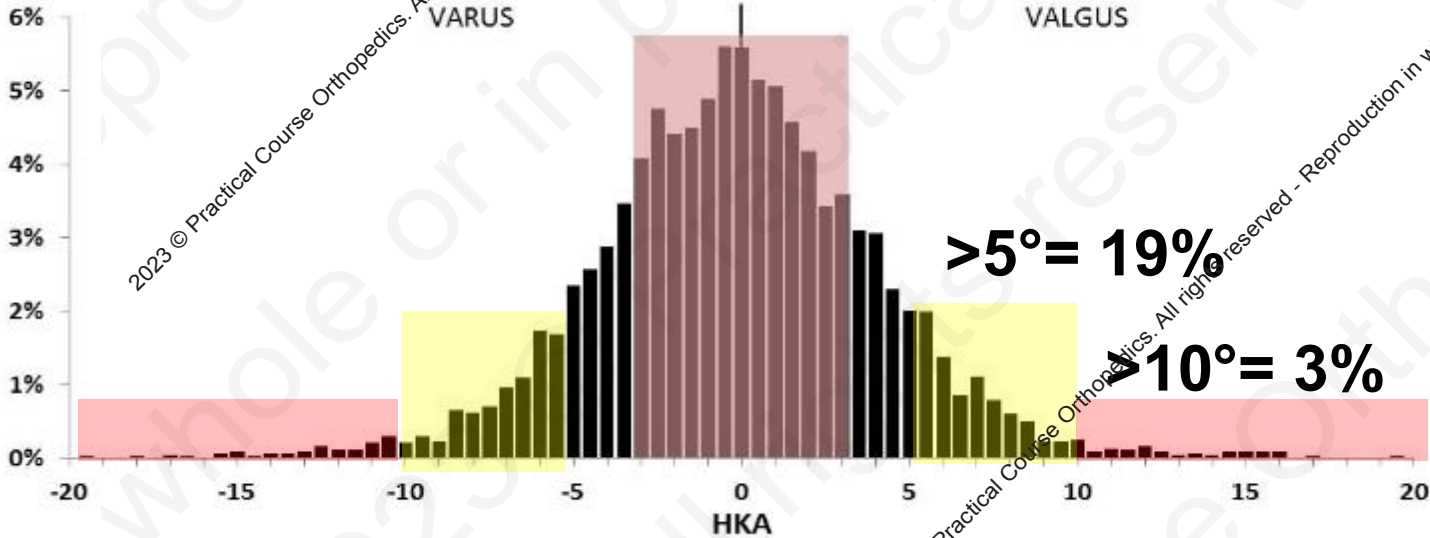
Pre Op Anatomy 4800 Knees

The Impact of Mechanical and Restricted Kinematic Alignment on Knee Anatomy in Total Knee Arthroplasty

Abdulaziz M. Almaawi, MD, MSc, FRCSC ^a, Jonathan R.B. Hutt, MA, MBBS, FRCS (Tr+Orth) ^b, Vincent Masse, MD, FRCSC ^a, Martin Lavigne, MD, MSc, FRCSC ^a, Pascal-Andre Vendittoli, MD, MSc, FRCSC ^{a,*}

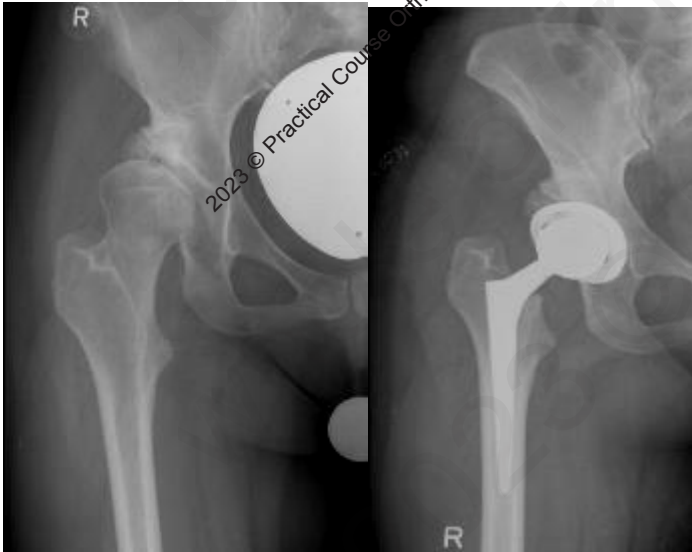
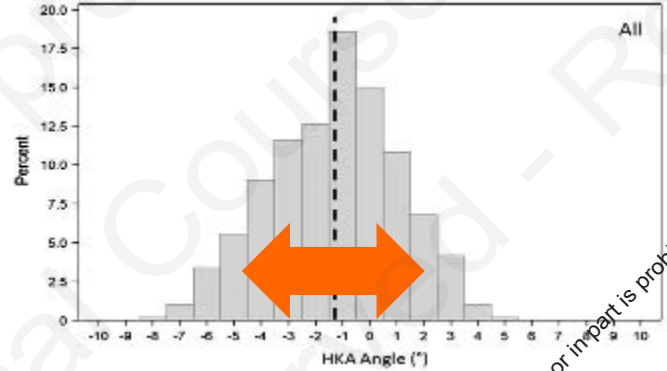
The Journal of Arthroplasty

Mean HKA 0.1°



KA What should be the Limits?

What is a normal anatomy?
Compatible with an implant?



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Coronal Alignment and TKA Survivorship Mechanical Alignment

Effect of Postoperative Mechanical Axis Alignment on
Survival and Functional Outcomes of Modern Total
Knee Arthroplasties with Cement

A Concise Follow-up at 20 Years*

Mathew P. Abdel, MD, Matthieu Ollivier, MD, Sebastien Parratte, MD, PhD, Robert T. Trousdale, MD, Daniel J. Berry, MD, and
Mark W. Pagnano, MD

No Corelation

HKA +/- 3°

rKA principle #1

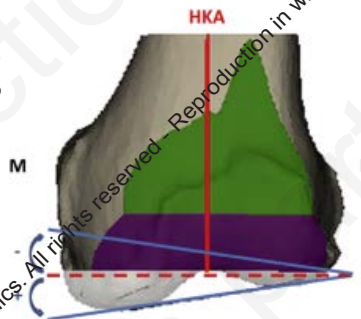
Joint Orientation

The Impact of Mechanical and Restricted Kinematic Alignment on Knee Anatomy in Total Knee Arthroplasty

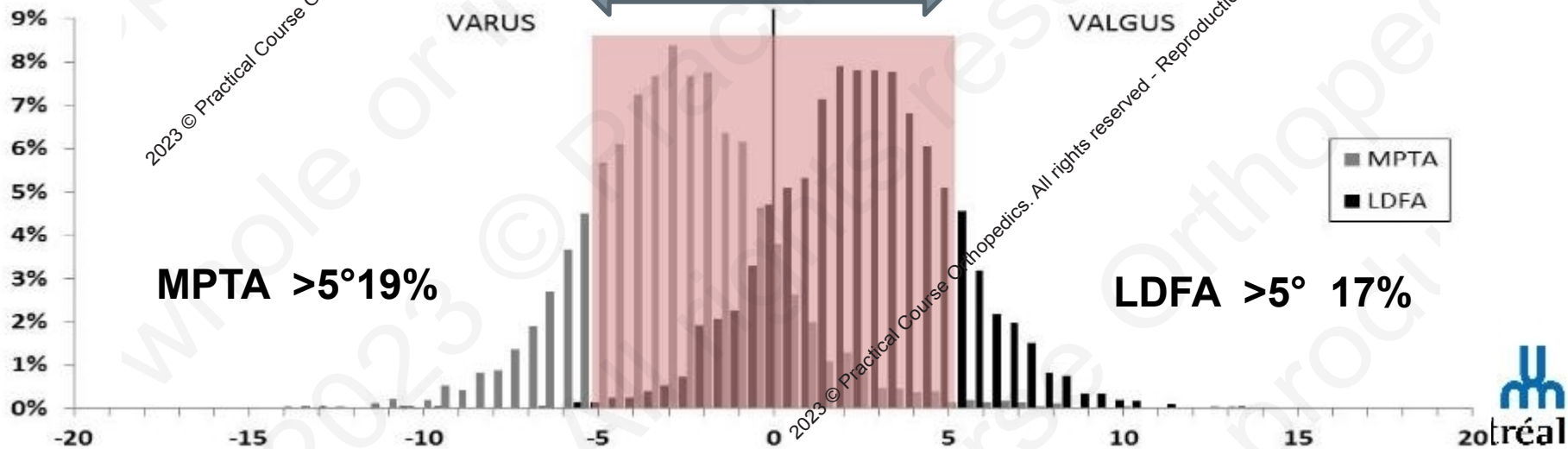
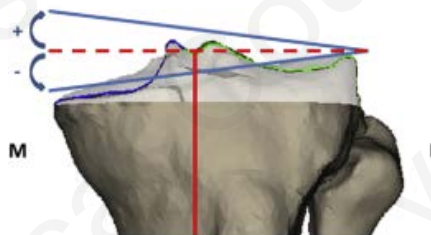
Abdulaziz M. Almaawi, MD, MSc, FRCSC^a, Jonathan R.B. Hutt, MA, MBBS, FRCS (Tr+Orth)^b, Vincent Masse, MD, FRCSC^a, Martin Lavigne, MD, MSc, FRCSC^a, Pascal-Andre Vendittoli, MD, MSc, FRCSC^{a,*}

The Journal of Arthroplasty

Femur 2.7°
mean



Tibia 2.9°
mean

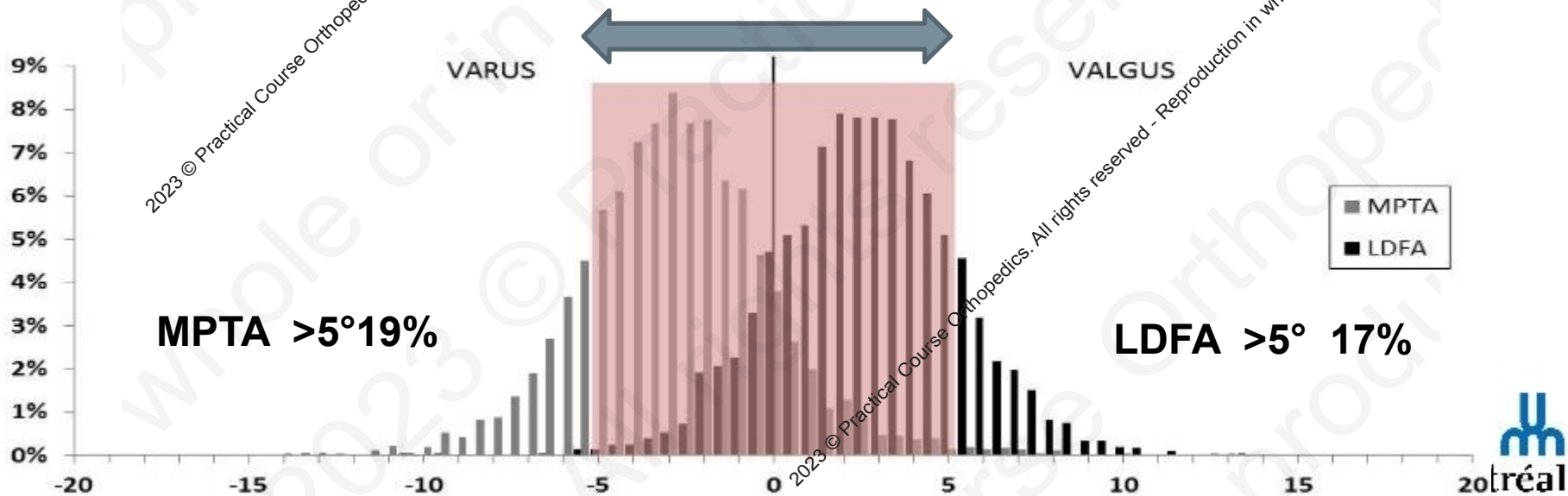


Joint Orientation

Femur 2.7°
mean

rKA principle #2
limits +/- 5°
+2° versus the mean

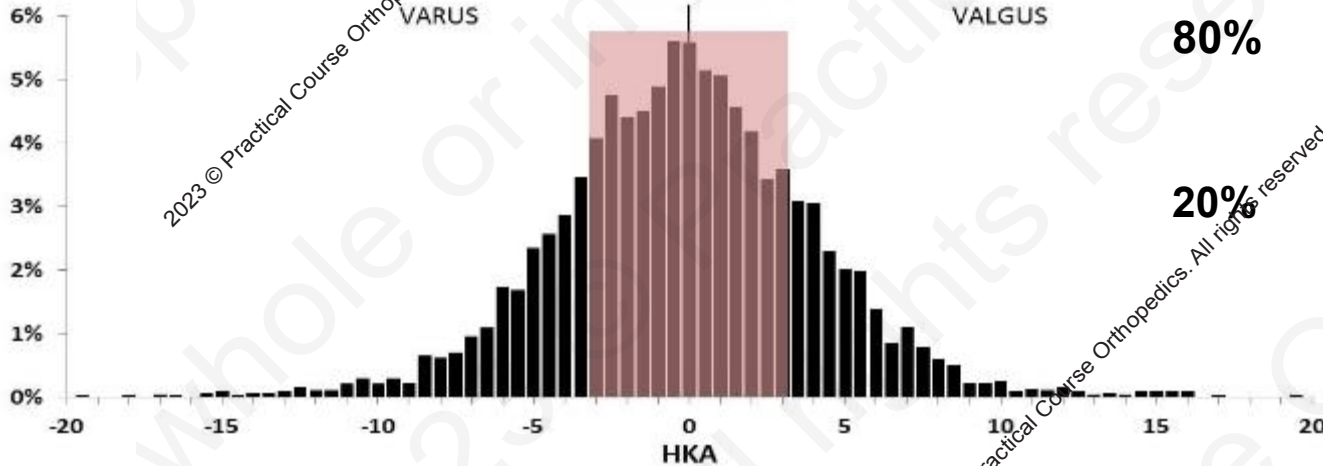
Tibia 2.9°
mean



Abdulaziz M. Almaawi, MD, MSc, FRCS^a, Jonathan R.B. Hutt, MA, MBBS, FRCS (Tr+Orth)^b,
Vincent Masse, MD, FRCS^a, Martin Lavigne, MD, MSc, FRCS^a,
Pascal-Andre Vendittoli, MD, MSc, FRCS^{a,*}

rKA limits includes a majority of anatomies

HKA +/- 3°
L DFA and MPTA max 5°



51% of the knees
No modifications
True KA

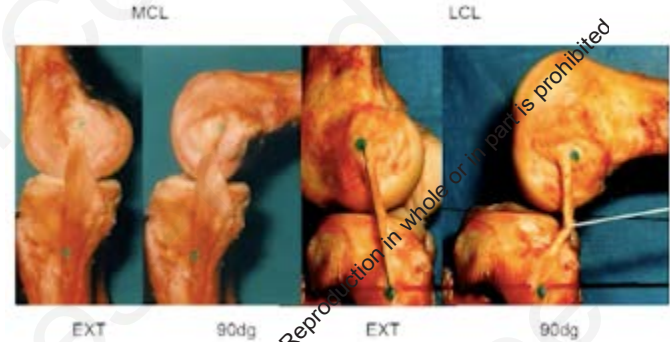
80%
mean corrections
Tibia: 0.5°
Femur: 0.3°

20%
more important
adjustments are
required

Collateral Ligaments' Tensions/Laxities

- High individual variability
- Women are more lax
- MCL tighter than LCL
- Both collateral ligaments are tighter in extension than in flexion

Coll. ligaments are not isometric



Clin Orthop Relat Res (2014) 472:3426–3421
DOI 10.1007/s11999-014-3865-6

CLINICAL RESEARCH

Collateral Ligament Laxity in Knees: What Is Normal?

Kamal Deep MBBS, MS, DNB, FRCS, MCh Orth, FRCS(Orth)

Clinical Orthopaedics
and Related Research
A Publication of The International Journal of Orthopaedics

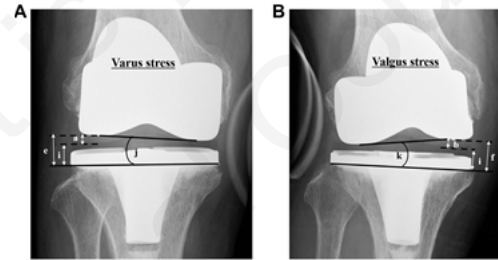
Correlation Between Kinematics, Clinical Results and Ligament Laxity



The Influence of Postoperative Knee Stability on Patient Satisfaction in Cruciate-Retaining Total Knee Arthroplasty

Tomoyuki Kamenaga, MD ^a, Hirotosugu Muratsu, MD, PhD ^{a,1}, Yuta Kanda, MD ^b, Hidetoshi Miya, MD ^a, Ryosuke Kuroda, MD, PhD ^b, Tomoyuki Mochimaru, MD, PhD ^b

^a Department of Orthopaedic Surgery, Saitoh Memorial Musakita Hospital, Hiroshi, Japan
^b Department of Orthopaedic Surgery, Kobe University Graduate School of Medicine, Kobe, Japan



Journal of Biomechanics 38(12):2511-2516

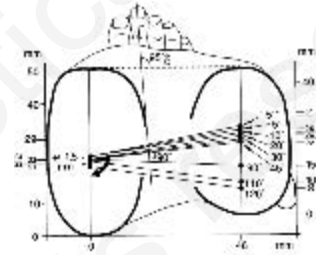
JOURNAL OF BIOMECHANICS

www.elsevier.com/locate/jbiomech
 www.Elsevier.com

The movement of the normal tibio-femoral joint

M.A.R. Freeman^{a,b,c,*}, V. Pinskirova^c

^a Institute of Biomechanics and Anatomical Science, University College, 2012 Hill Gardens, UK
^b School of Engineering, Medicine, Aston University, Birmingham, UK
^c The Royal Victoria Hospital, Leeds, UK
 *Present Address: Centre for Health, Exercise and Performance Research, Royal Holloway

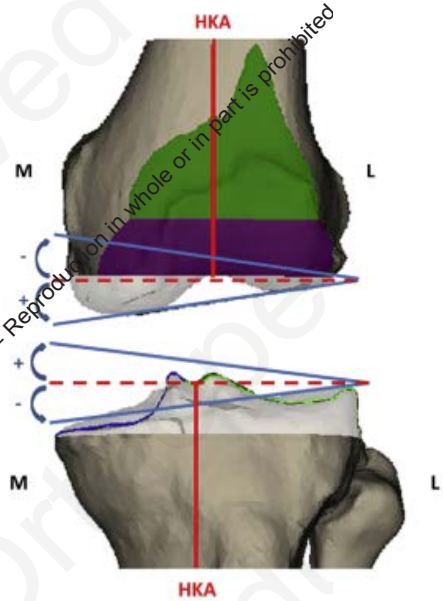


rKA principle #3: aim to restore native ligament laxities
 No gap balancing related technique

rKA Principles

1. HKA limits = $\pm 3^\circ$
2. Joint obliquity limits to 5°
3. Restore native ligament laxities

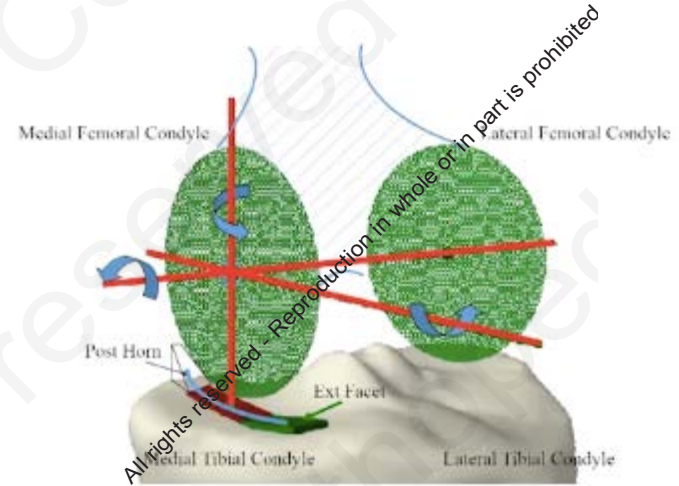
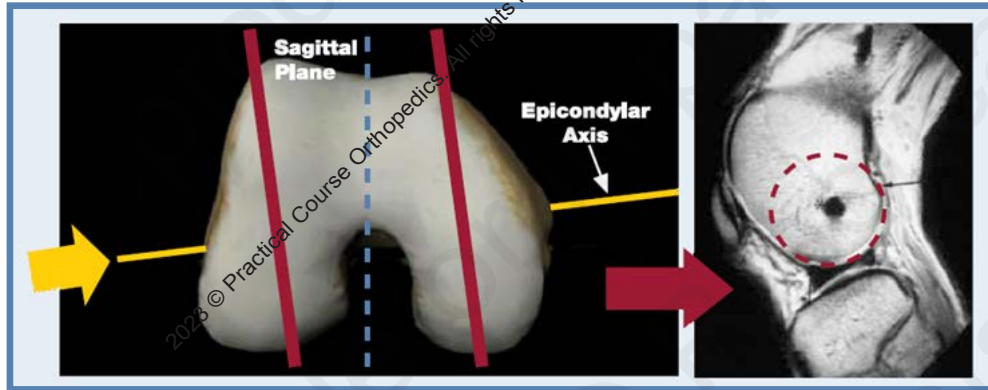
When anatomy adjustments are required,
where should it be performed ?
Tibia or Femur or Both ?



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Femur is the leader of the joint kinematics

When anatomy modifications are needed, femoral flexion axis / cylindrical axis should be maintained



4th rKA Principle: Favors Femoral Anatomy Preservation

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rKA Principles

1. HKA limits = +/- 3°
2. Joint obliquity limits to 5°
3. Restore native ligament laxities
4. Adjust the contributing bone but favor femoral anatomy preservation

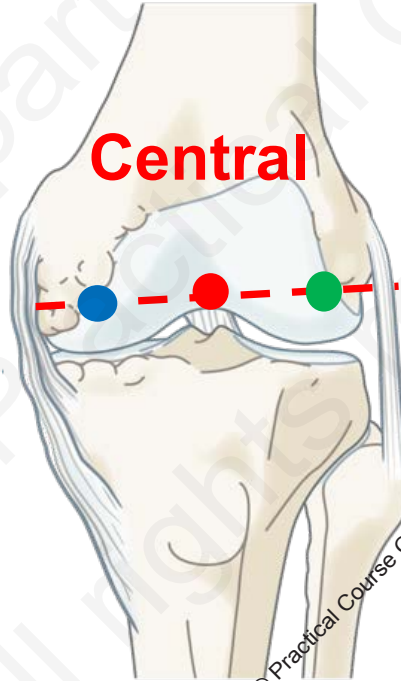
Where should be the pivot point for the resection modification?

If modification are required, where should be the pivot point determining the resection

modification?

My preference is to resurface the intact compartment and adjust the diseased one

Worn Side



Intact side

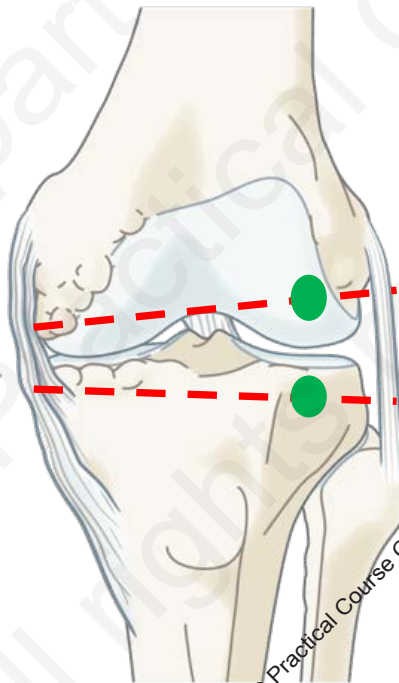
If modification are required, where should be the pivot point determining the resection modification?

My preference is to resurface the intact compartment and adjust the diseased one

Severe Varus knee

Prosthesis = 20mm
Resection = 16mm

9 mm
7 mm



10 mm
10 mm

Prosthesis = 20mm
Resection = 20mm

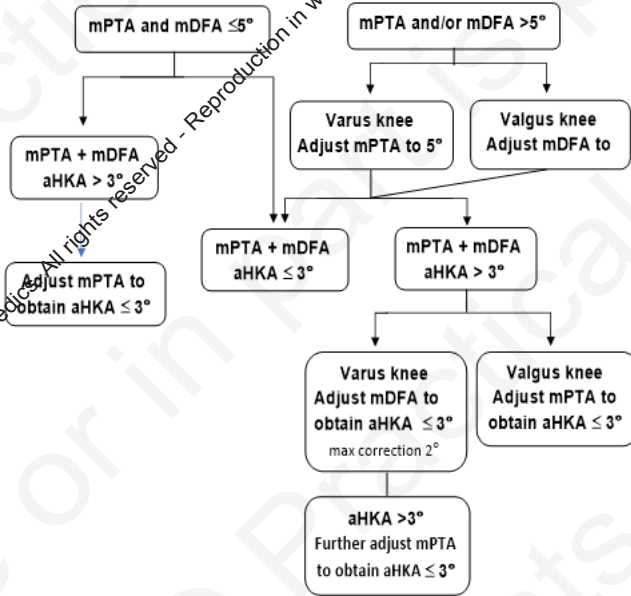
>2 mm gap difference
Minimal release: deep MCL

rKA Principles

1. HKA limits = +/- 3°
2. Joint obliquity limits to 5°
3. Restore native ligament laxities
4. Adjust the contributing bone but favour femoral anatomy preservation
5. **Resurface the intact compartment**
 - Varus = lateral pivot point
 - Valgus = medial pivot point

Restricted KA

Vendittoli 2011



Restricted Kinematic Alignment, the Fundamentals, and Clinical Applications

Pascal-André Vendittoli^{1,2,3,4*}, Sagi Martinov¹ and William G. Blakeney⁵

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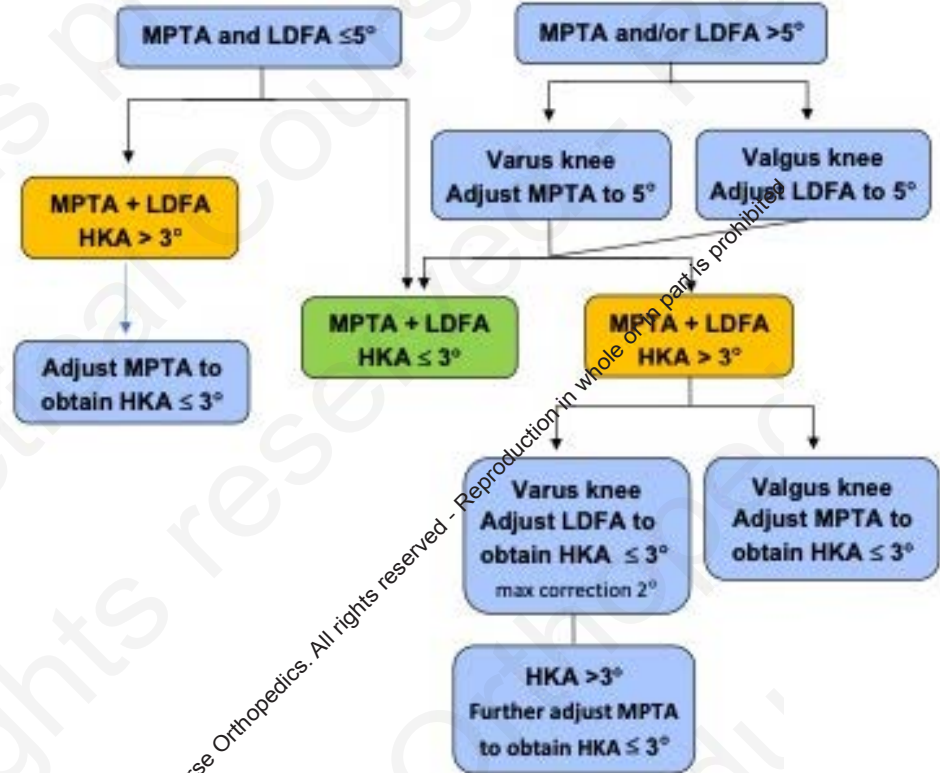
Men 57

Right Lower limb

mHKA 3 varus

Femur 2 valgus

Tibia 3 varus





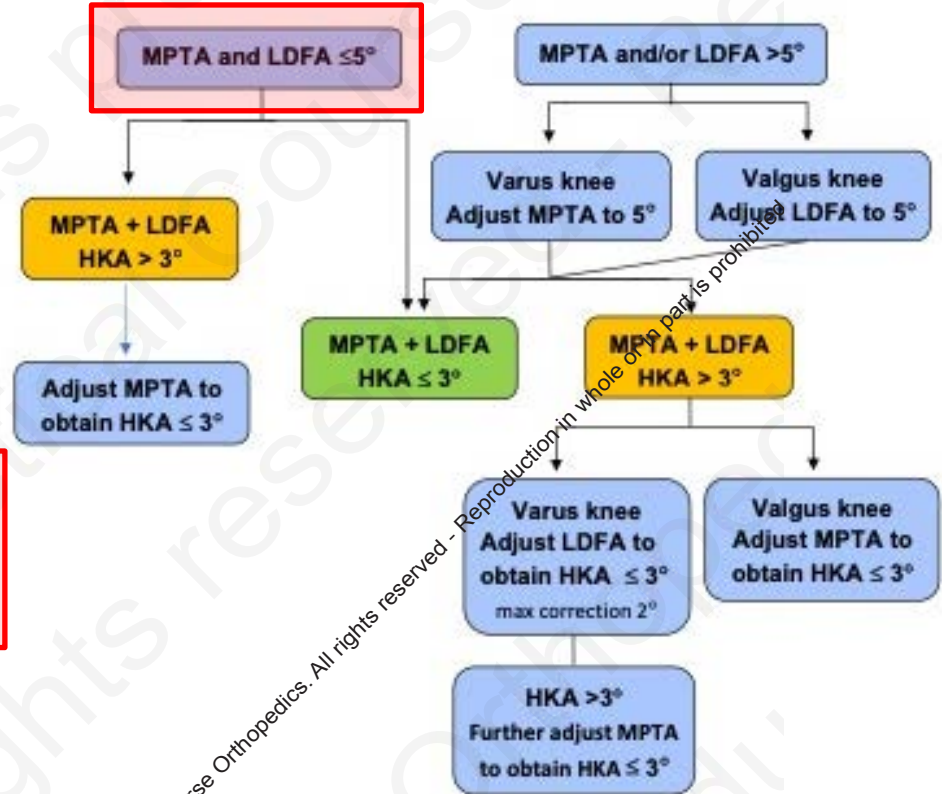
Men 57

Right Lower limb

mHKA 3 varus

Femur 2 valgus

Tibia 3 varus





Men 57

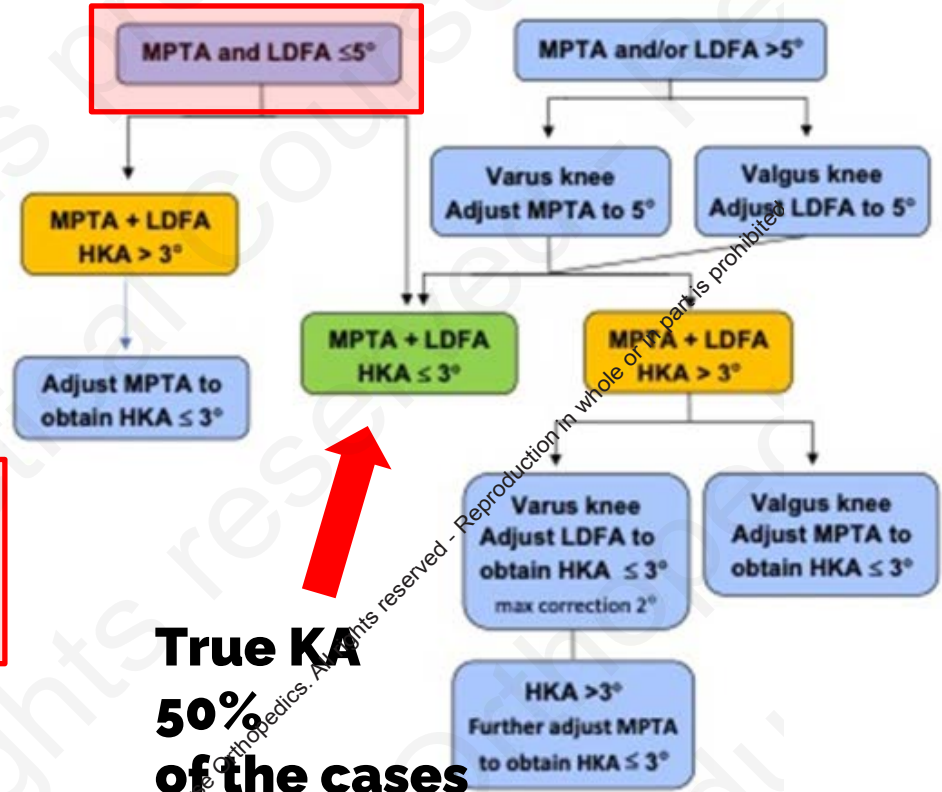


lower limb

3 varus

2 valgus

3 varus

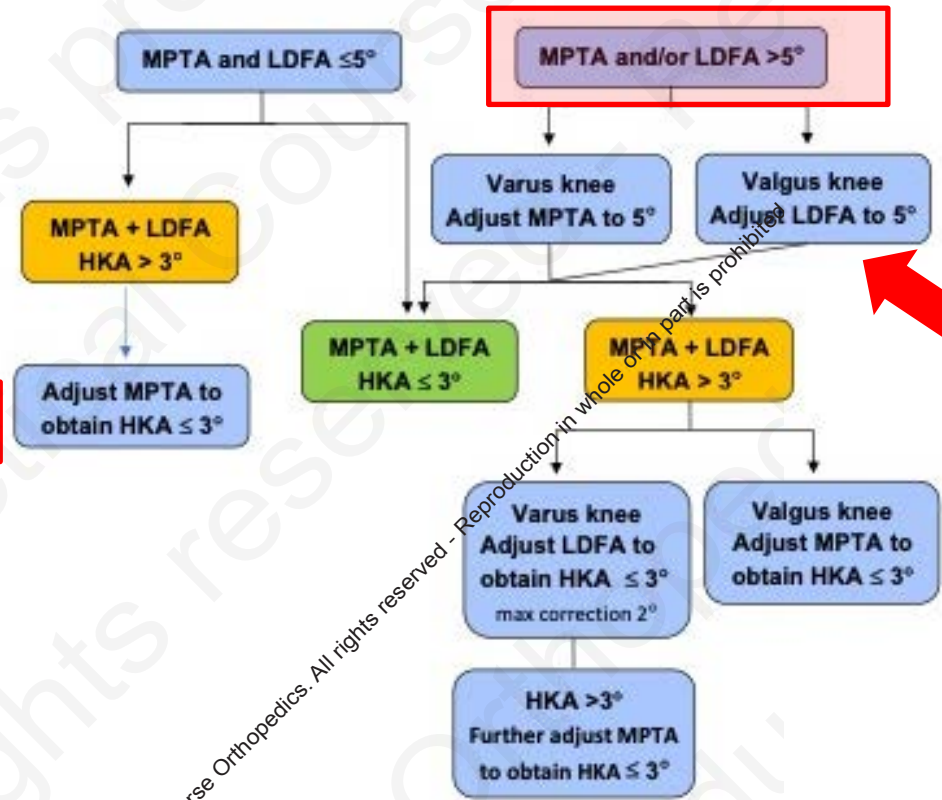


True KA
50%
of the cases

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Women 82 y
 Right Lower limb
 mHKA 17 valgus
 Femur 9 valgus = 5
 Tibia 2 varus





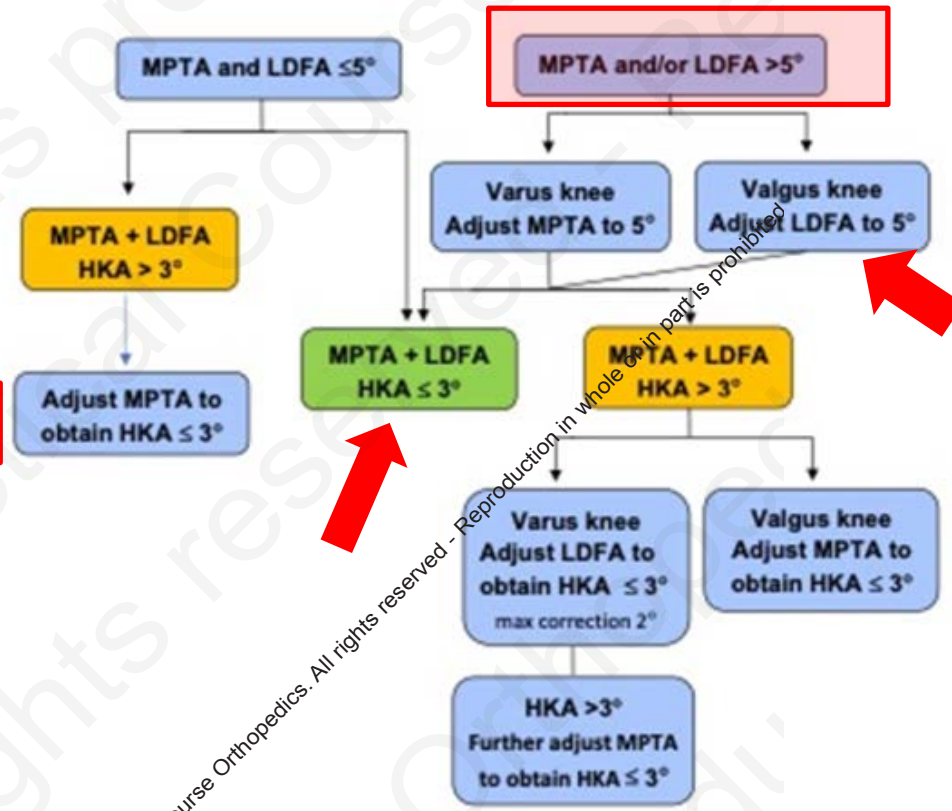
Women 82 y

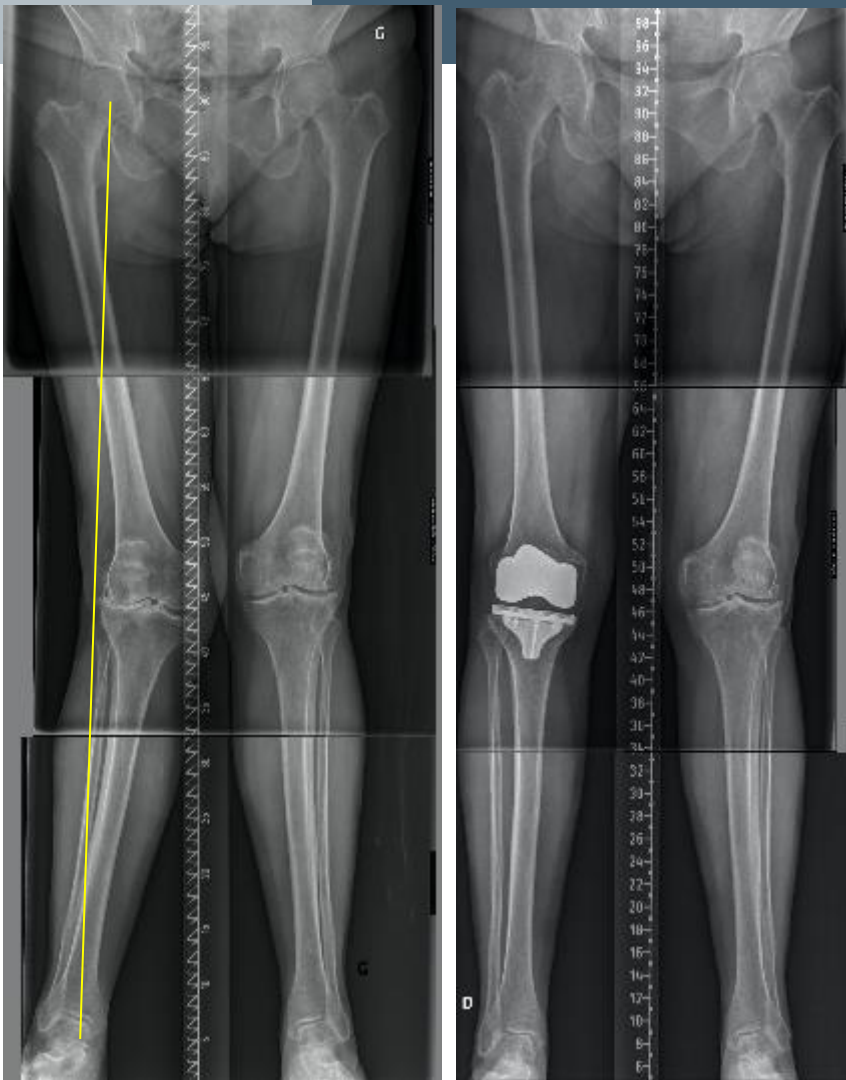
Right Lower limb

mHKA 17 valgus

Femur 9 valgus = 5

Tibia 2 varus

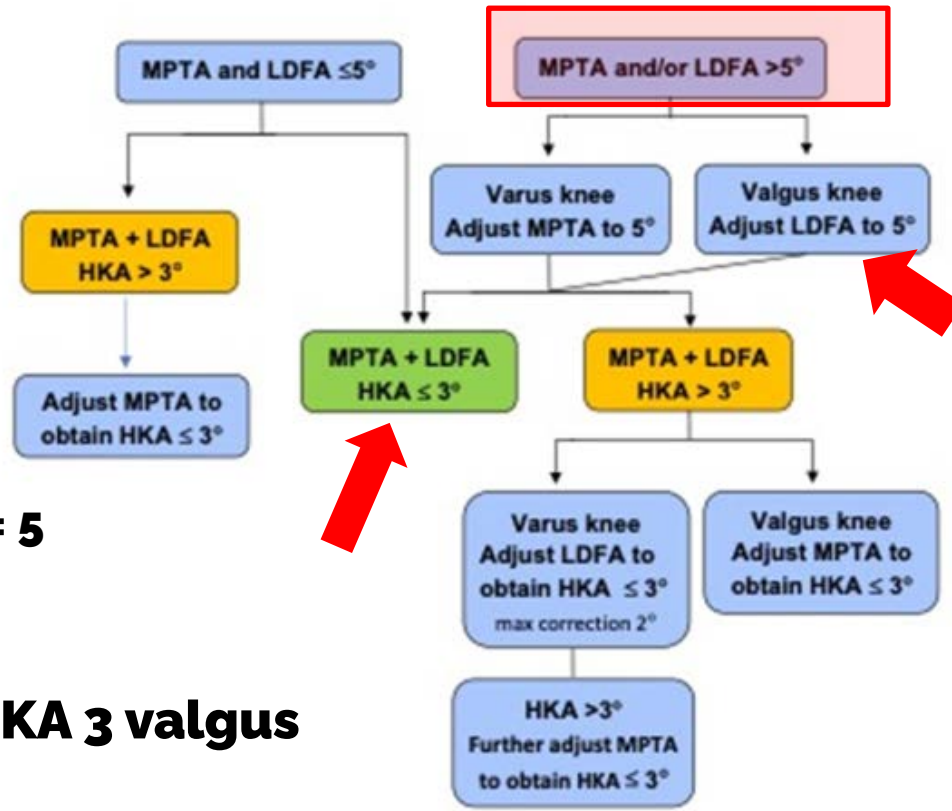




o

us = 5

HKA 3 valgus





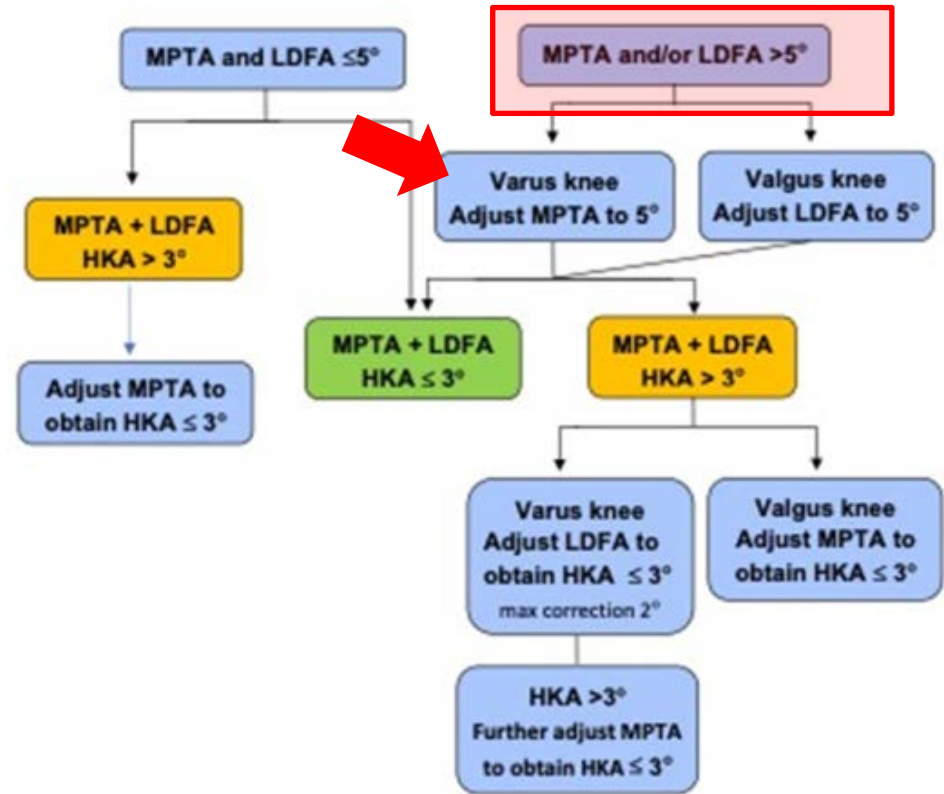
Men 73 y

Left Lower limb

mHKA 25 varus

Femur 1 valgus

Tibia 10 = 5 varus





Men 73 y

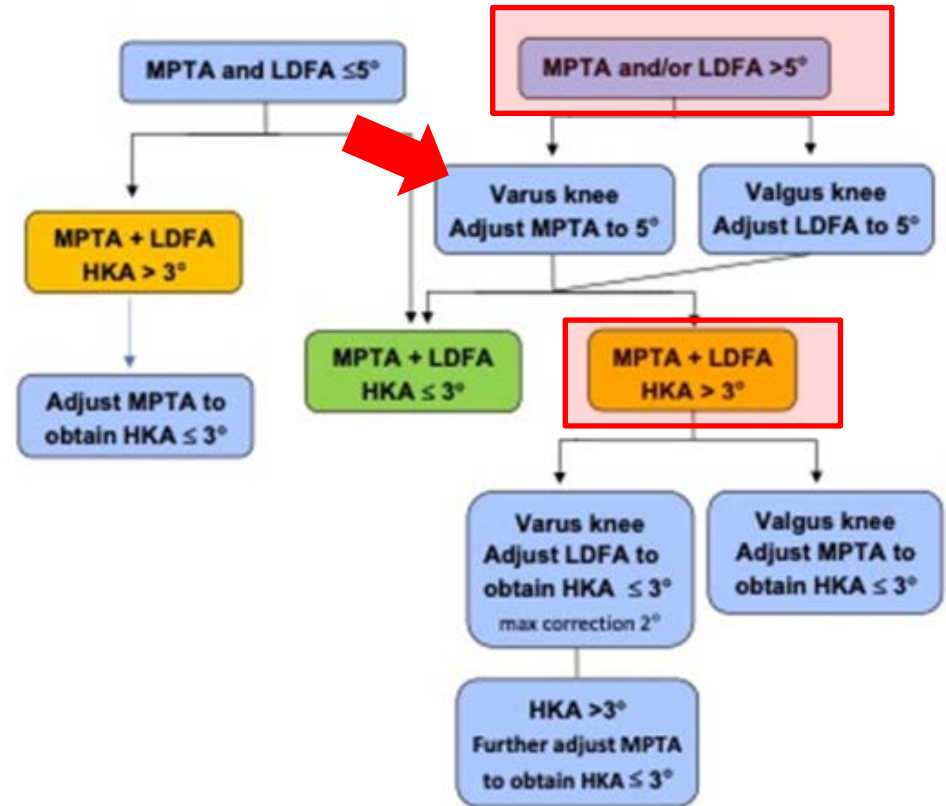
Left Lower limb

mHKA 25 varus

Femur 1 valgus

Tibia. 10 = 5 varus

4 varus





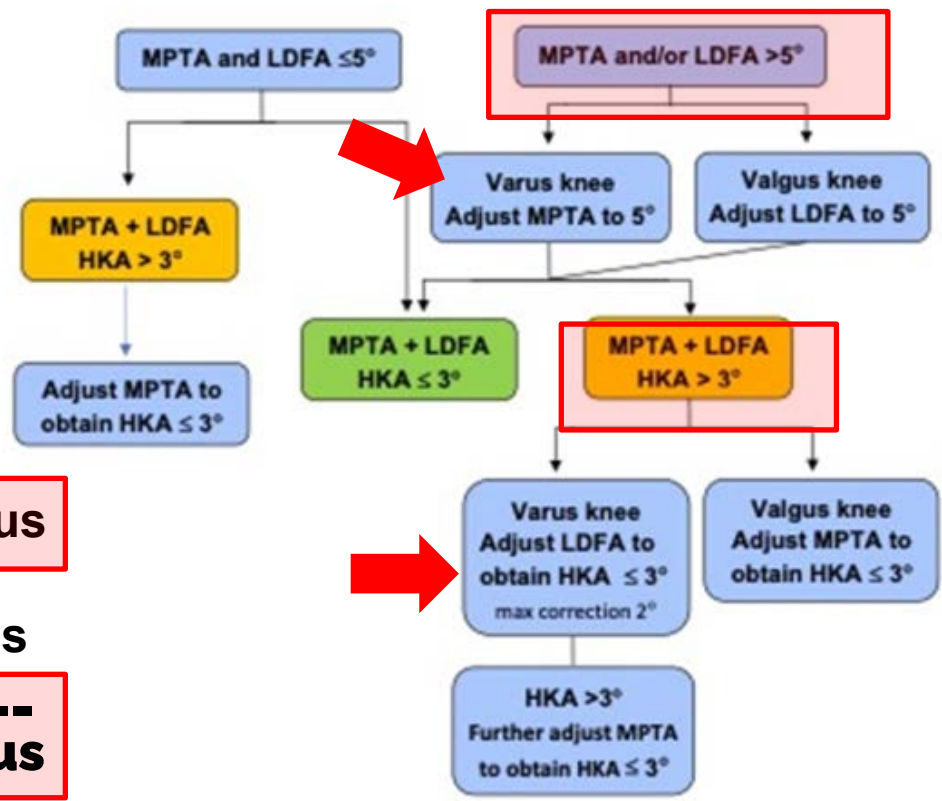
Femur

1 = 2 valgus

Tibia

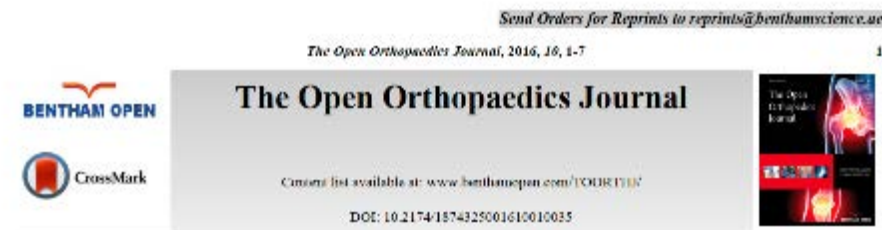
10 = 5 varus

3 varus



rKA for UKA Revision

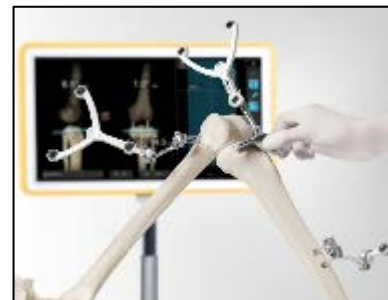
2016



RESEARCH ARTICLE

Anatomic Versus Mechanically Aligned Total Knee Arthroplasty for Unicompartmental Knee Arthroplasty Revision

Panagiota Toliopoulos^{1,2}, Marc-Andre LeBlanc¹, Jonathan Hut¹, Martin Lavigne^{1,2}, Francois Desmeules¹ and Pascal-Andre Vendittoli^{1,2}



10 rKA UKA revisions

11 MA UKA revisions

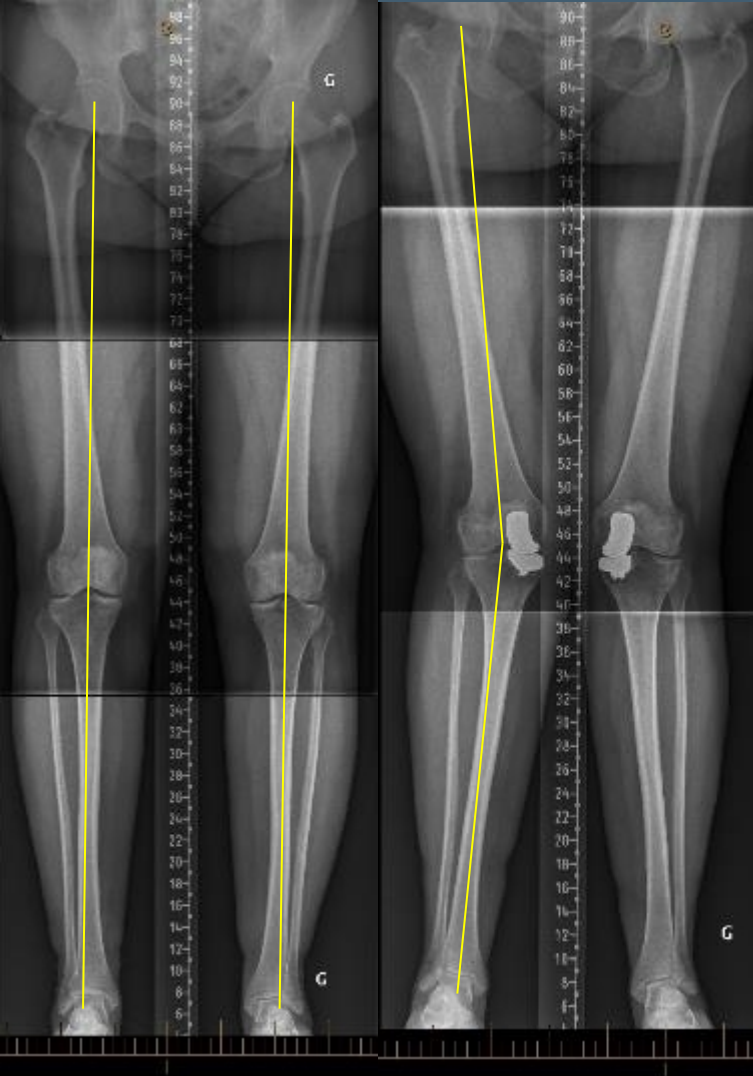
Less augment (1/10)

Less stem (1/10)

Thinner poly

Better WOMAC 91 vs 78 (p=0.049)

No revision at last FU

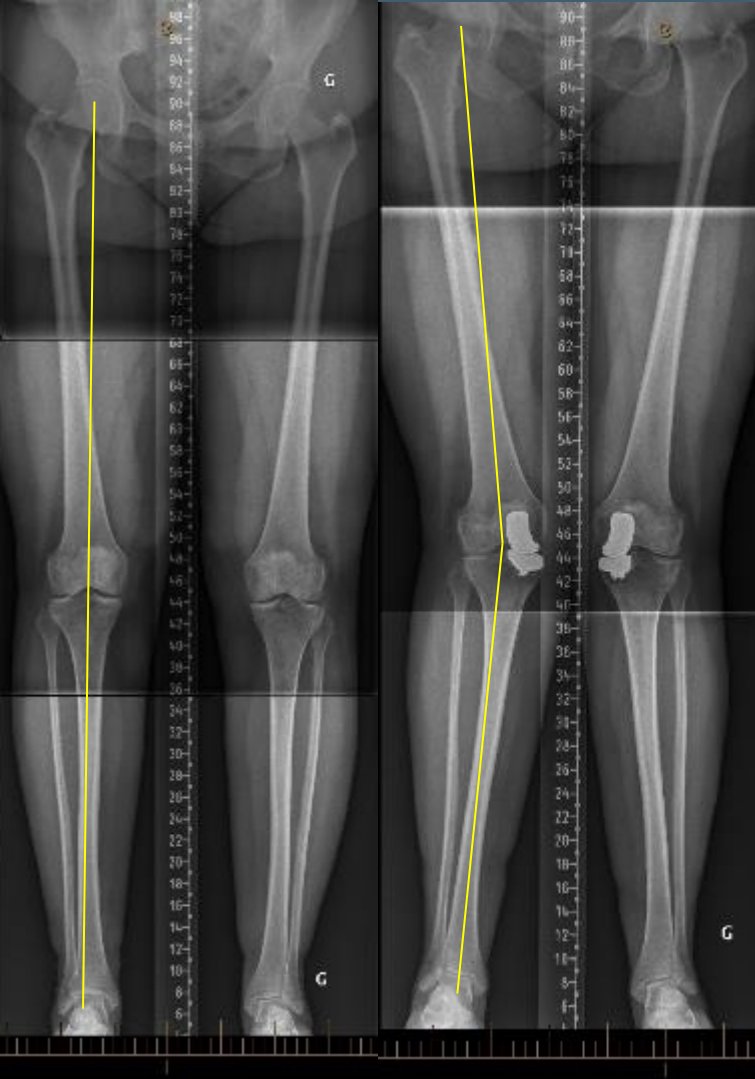


Women 60 y, 2y post op

Right Lower limb	PRE OP	post UKA
mHKA	0.5 varus	11 valgus
Femur	0	3 valgus
Tibia	0.5 varus	6 valgus

Overstuffed medial compartment and lateral OA 2y post-op





mHKA
Femur
Tibia

Native

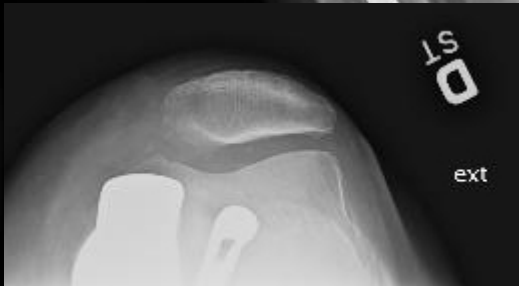
0.5 varus
0
0.5 varus

Post revision

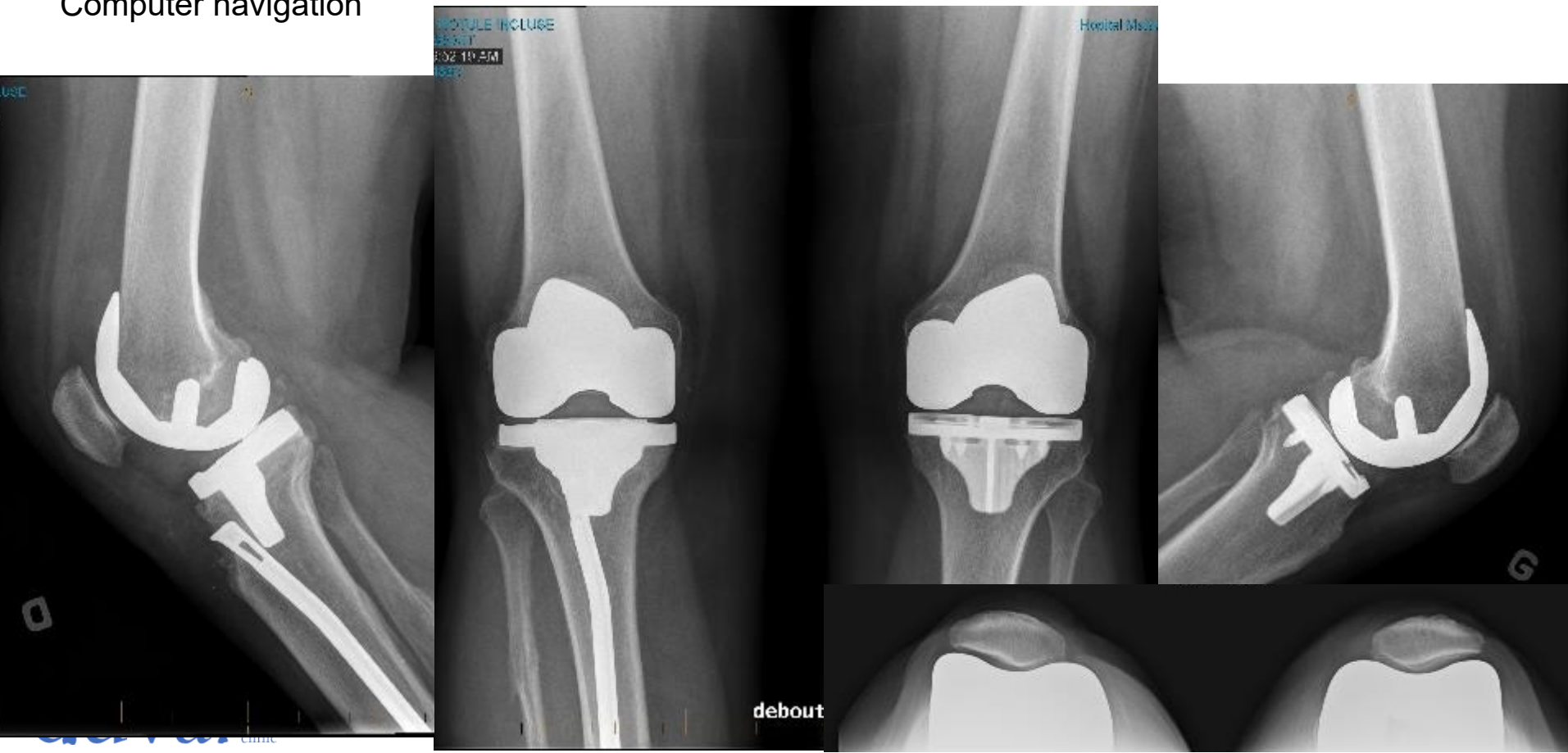
0
0.5 valgus
0.5 varus



Men 64 y with previous R tibial fx and UKA 2y ago
Right tibial implant loosening



Bilateral knee replacement: left primary TKA first then right UKA revision
Computer navigation





Revision Total Knee Arthroplasty With the Use of Restricted Kinematic Alignment Protocol: Surgical Technique and Initial Results

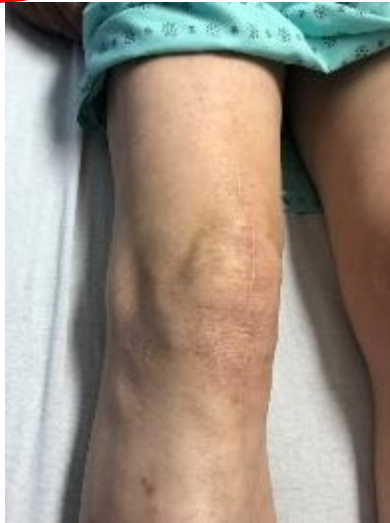
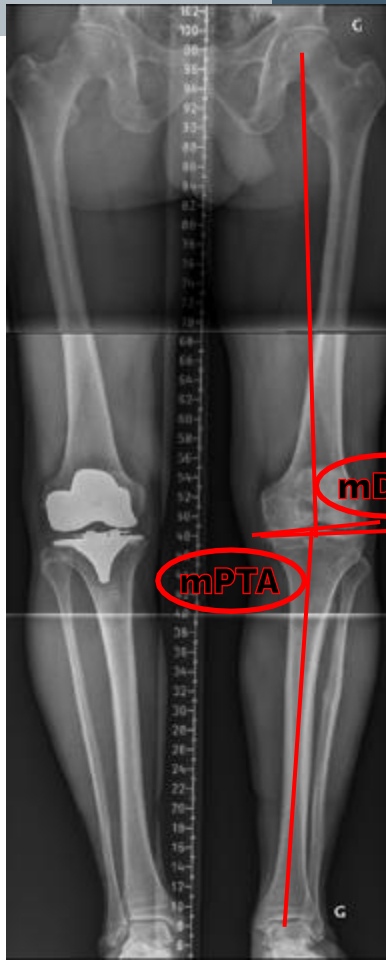
*Lazaros Kostretzis¹, Gabriel Bouchard Roby¹, Sagi Martinov¹, Marc-Olivier Kiss^{1,2},
Janie Barry¹ and Pascal-André Vendittoli^{1,2,3*}*

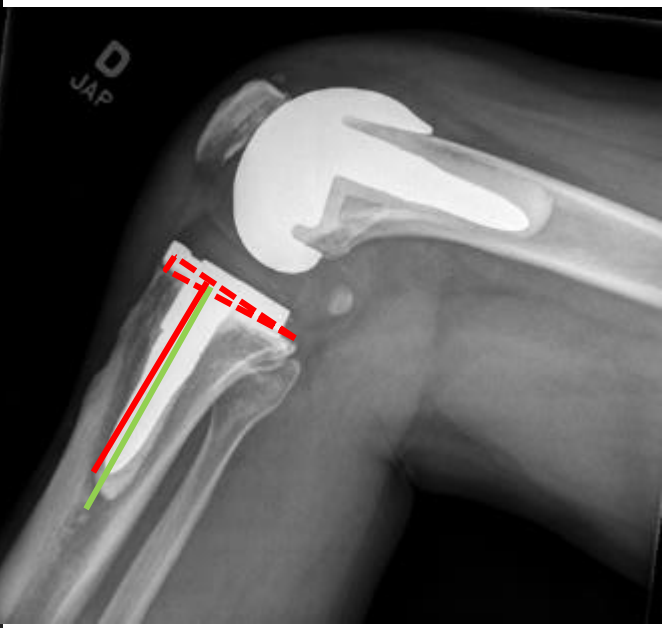
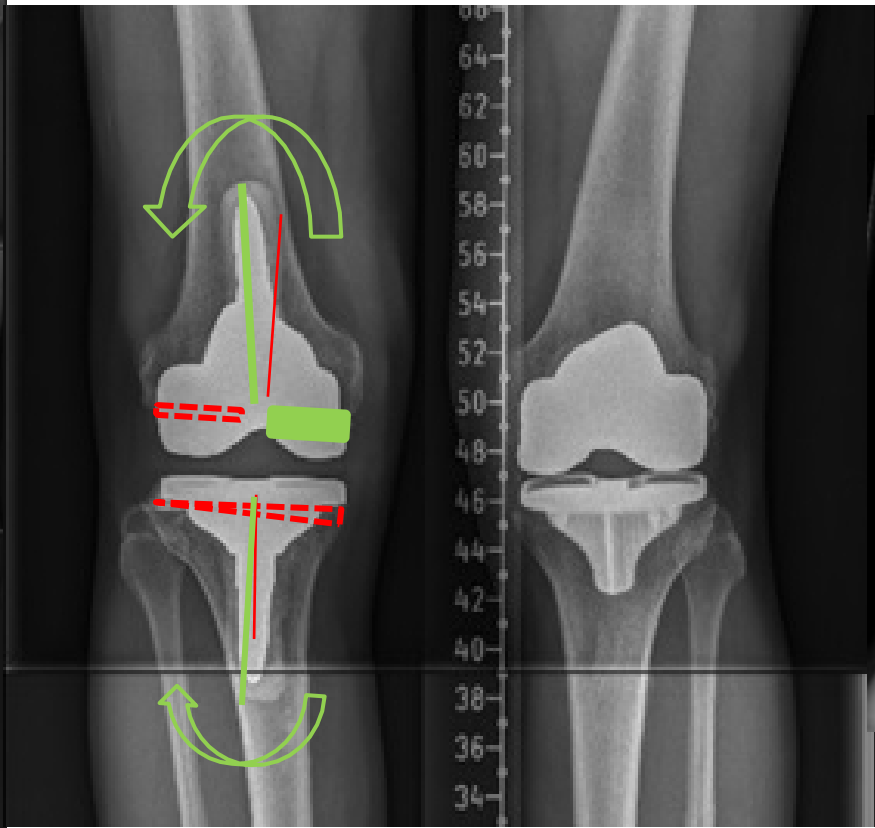
Case example

Male 61 y, 2y post right TKA
Instability, pain, MCL laxity

Vs contralateral
Femur in varus +7 degrees
Tibia -2 degrees varus
Tibial slope +4.5 degrees

Femoral joint line looks elevated





We Need to Define the Limits of Personalized Arthroplasty

Knee

COB | VOLUME 6 | OCTOBER 2021
 DOI: 10.1002/cob.24162
 www.efortopenreviews.org



EFORT open reviews

Specific case consideration for implanting TKA with the Kinematic Alignment technique

Charles Rivière¹
 William Jackson^{4,5}
 Loïc Villet^{1,4}
 Sivan Sivaloganathan^{1,6}
 Yaron Barziv^{4,7}
 Pascal-André Vendittoli^{4,8}

Table 1. PAS (Personalized Arthroplasty Society) classification of most commonly occurring challenging for 'physiological' TKA implantation

PAS classification of most commonly occurring challenging situations that a surgeon may face when aiming

Knee types	1	2	3	4	5	6	7	8
Description of the osteoarthritic knee/limb	Severe constitutional varus limb	Severe constitutional valgus limb	Extreme constitutional joint line orientation (severe frontal joint line obliquity, high tibial posterior slope)	Patella maltracking	Difficulty in estimating native knee anatomy (mainly articular bone loss)	Acquired lower limb malalignment from previous fracture malunion, osteotomy or metabolic bone disease for example	Cases with severe soft tissue modifications	- global instability (recurvatum) - severe contractures



then aim
 tion
 optional c
 e KA/rk
 is not
 recommende

Not physiologic anymore

Extra articular deformities



Collateral Ligament Insufficiency

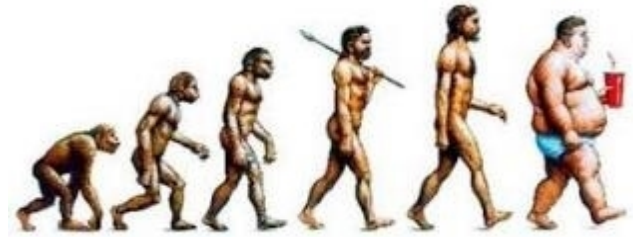


Severe Contracture



Hemophilic arthropathy

Why not Reproducing All Anatomies ? Evolution is not as predicted...



Same bony anatomy but different envelope



How to Perform rKA TKA?



Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

Original article

Kinematic TKA using navigation: Surgical technique and initial results

J.R.B. Hutt, M.-A. LeBlanc, V. Massé, M. Lavigne, P.-A. Vendittoli*

Université de Montréal, Hôpital Maisonneuve-Rosemont, Department of Surgery, 5415 boulevard de l'Assomption, Montréal, QC H1T 2M4, Canada

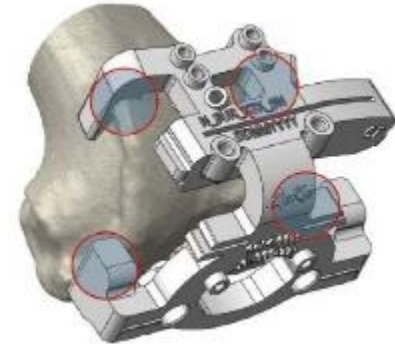
Navigation



« Robotic assistance »



Personalised Instruments (PSI)



Restricted Kinematic Alignment

2011-2015 = cemented

2015-2023 = uncemented

Stopped patella resurfacing 2016

0 revision for loosening

Orthopaedics & Traumatology: Surgery & Research 102 (2016) 99–104



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EM|consulte

www.em-consulte.com/en

Original article

Kinematic TKA using navigation: Surgical technique and in

Knee Surgery, Sports Traumatology, Arthroscopy

<https://doi.org/10.1007/s00167-020-06427-1>

KNEE

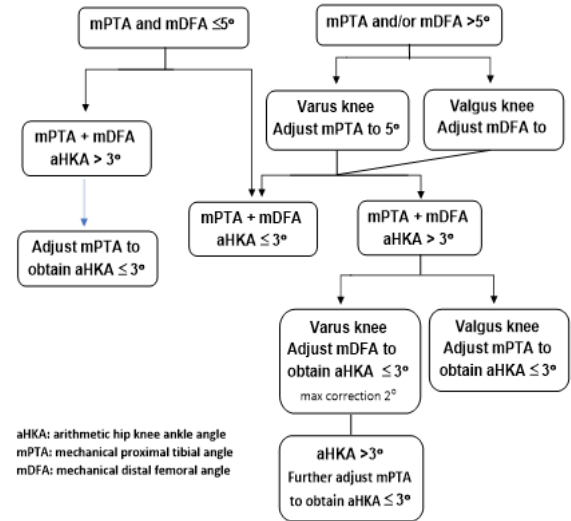
J.R.B. Hutt, M.-A. LeBlanc, V. Massé, M. Lavigne, P.-A. Vendittoli*

Université de Montréal, Hôpital Maisonneuve-Rosemont, Department of Surgery, 5415 boulevard de l'Assomption, Montréal, QC J5

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Restricted kinematic alignment leads to uncompromised osseointegration of cementless total knee arthroplasty

Guillaume Laforest¹ · Lazaros Kostretzis¹ · Marc-Olivier Kiss^{1,2} · Pascal-André Vendittoli^{1,2,3}



rKA and the Quest for the Forgotten Joint



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org



Perception of a Natural Joint After Total Knee Arthroplasty

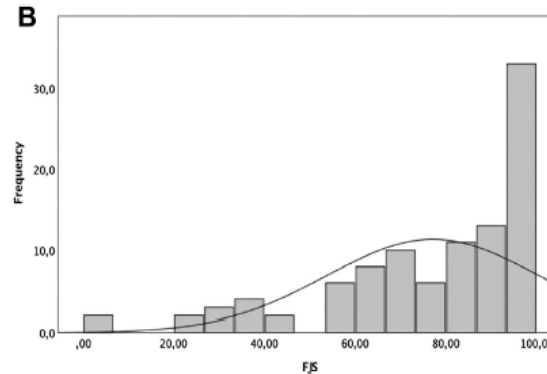
David Eichler, MD, MSc ^a, Yann Beaulieu, MD ^a, Janie Barry, MSc ^a,
Vincent Massé, MD, FRCS(c) ^{a,b}, Pascal-André Vendittoli, MD, MSc, FRCS(c) ^{a,b,*}

^a Department of Surgery, CIUSSS-de-l'Est-de-l'Île-de-Montréal, Hôpital Maisonneuve Rosemont, Montréal, Québec, Canada

^b Department of Surgery, Université de Montréal, Montréal, Québec, Canada

100 KA TKA, 40 months

Mean Forgotten Joint Score = 77



American population = 67

UKA = 67-74

TKA (MA) = 55-65

Yes, The Ideal Compromise

rKA is a great alternative to MA to better reproduce patients' anatomy, function and ligament balance while keeping the lower limb alignment in a safe range

Since 2011, no revision for loosening

Downside: you need a precision tool

Pay attention to definitions and surgical technique descriptions, not all restricted KA are the same...



PERSONALIZED ARTHROPLASTY SOCIETY

**Join us for the 2023 PAS Scientific
Session & Annual Meeting for
Personalized Hip and Knee
Replacement**

**December 1-2, 2023
Bordeaux, France**



personalizedarthroplasty.org/events