

Quelle est l'influence du design sur les résultats?

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Conflit d'intérêt

- Consultance: Smith+Nephew
Arthrex

Les Challenges actuelles des firmes en terme d'implants

- Patients de + en + jeunes  durée de vie + Performances
- Patients de + en + âgé fragile et ostéoporitique  fixation et stabilité
- Patients de + en + exigeants  « genou oublié »

Situation actuelle

15-20% insatisfaits



PTG: activités sportives de **42%**
à **34%**



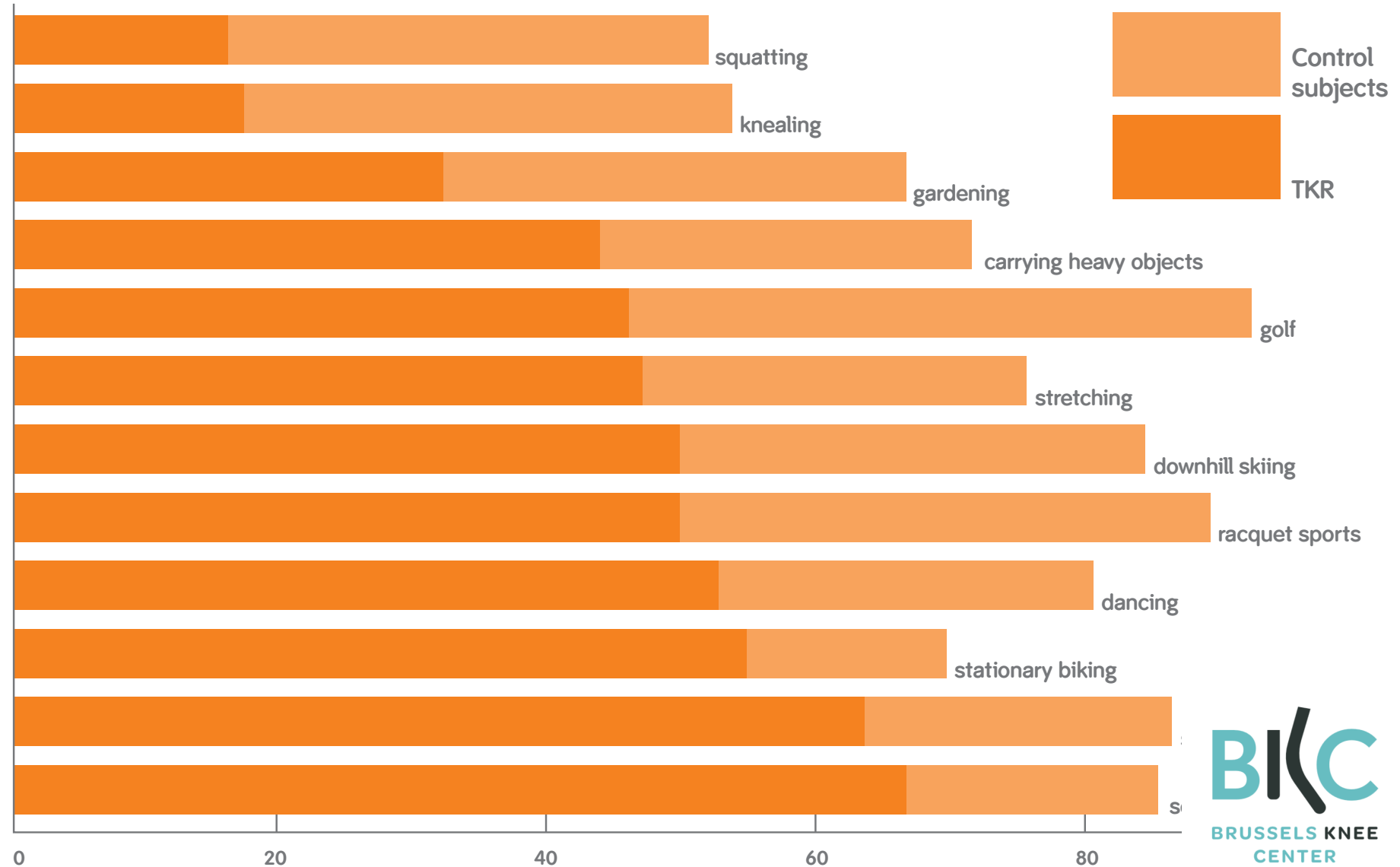
PTH: activités sportives de
36% à 52%

- 1. Scott CE, et al. *J Bone Joint Surg Br.* 2010; 92-B(9):1253-1258.
- 2. Bourne RB, et al. *Clin Orthop Relat Res.* 2010; 468:57-63.
- 3. Huch K, et al. *Ann Rheum Dis.* 2005; 64:1715-1720



Situation actuelle.

Percent reporting no difficulty



1. Scott CE, et al. *J Bone Joint Surg Br.* 2010; 92-B(9):1253-1258.
2. Bourne RB, et al. *Clin Orthop Relat Res.* 2010; 468:57-63.
3. Huch K, et al. *Ann Rheum Dis.* 2005; 64:1715-1720.

Causes des plaintes – révision d'implants

Reasons for revision	n	per 100 OCY
Infection	21	0.27
Mechanical loosening	18	0.23
Pain	14	0.18
Fracture of bone around the joint	8	0.10
Implant instability	6	0.08
Breakage of the implant	2	0.03
Wear	0	0.00
Metal effects	0	0.00
Other	16	0.21



1. Scott CE, et al. *J Bone Joint Surg Br.* 2010; 92-B(9):1253-1258.
2. Bourne RB, et al. *Clin Orthop Relat Res.* 2010; 468:57-63.
3. Huch K, et al. *Ann Rheum Dis.* 2005; 64:1715-1720.

Historique du design prothétique

Linking Kinematic Theories to Implant Design

In order to understand the functional outcome differences produced by various implant designs, it is critical to first examine the thought progressions that led to these designs. Many of today's popular designs still adhere to outdated kinematic theories that require less conforming tibiofemoral articulation to produce rollback. However, instead of producing rollback, these designs have been shown to produce instability and limited function.^{2013,25} The eMP™ Knee System restores function by replicating the natural AP stability and medial-pivot motion of the knee.²⁰¹⁶

Kinematic Theories

First Generation

"Four-Bar Link" Theory:

- ▶ "The kinematics of the knee is guided by a four-bar link."⁹
- ▶ Axis of rotation located at the crossing point of the cruciate ligaments.
- ▶ Demonstrated as progressive rollback of the femur relative to the tibia.

1970

"Four-Bar Link Theory"

Implant Designs

Multi-Radius Knees:

- ▶ Designed to produce rollback.
- ▶ Rollback dictates limited tibiofemoral conformity.
- ▶ Commonly associated with anterior sliding, instability, and anterior knee pain.

Kinematic Theories

Second Generation

Single-Axis of Rotation:

- ▶ Hollister AM. The axes of rotation of the knee. 1993.¹
- ▶ Single flexion – extension axis runs through collateral ligament origins.
- ▶ Longitudinal axis of rotation passes through insertion of ACL on tibial plateau.

1990

Single-Axis of Rotation

Implant Designs

Single-Radius Knees:

- ▶ Designed to produce symmetric rollback and freedom of rotation about longitudinal axis.
- ▶ Lack of tibiofemoral congruency to allow central rotation.

Kinematic Theories

Latest Generation

Medial-Pivoting Kinematics:

- ▶ Medial side of the knee stays stable and demonstrates spinning kinematics.
- ▶ Lateral side moves anterior and posterior to accommodate rotation of the tibia.
- ▶ Sagittal view shows circular articulating surfaces.

2000

Medial-Pivoting Kinematics

Implant Designs

The Medial-Pivot Knee:

- ▶ Designed to promote medial stability and lateral mobility.
- ▶ Constant radius femoral component, both in the sagittal and coronal plane, is matched with a highly conforming medial compartment and less conforming lateral compartment to allow translation.

Les 1^{er} implants

1860



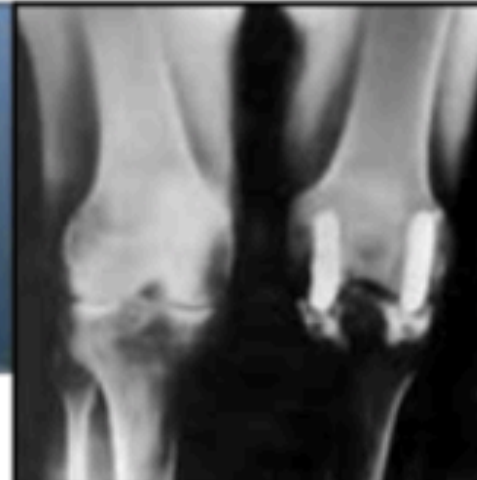
Implant : Charnière en ivoire¹
Concepteur : Gluck

1958



Implant : Charnière Walldius¹
Concepteur : Walldius

1968



Implant : Genou polycentrique^{1,2}
Concepteur : Gunston

1968



Implant : Genou à deux condyles^{1,2}
Concepteur : Ranawat, Insall, Shine

1974



Implant : Genou total condylien^{1,2}
Concepteur : Insall, Walker, Ranawat

1975



Implant : Genou New Jersey, ou genou à surface mobile porteuse Low Contact Stress

1978



Implant : Insall-Burstein (I/B[®]) Genou à stabilisation postérieure (PS) (Zimmer)²

1982



Implant : ORTHOLOC[®] (Wright, désormais MicroPort Orthopedics)³
Concepteur : Whiteside

1^{ère} génération: contrôle de la douleur (CrCO)

Concepteur : Buechel, Pappas

1983



Implant : AGC[®] (Biomet)⁴
Concepteur : Ritter & Daniel

1984



Implant : Système total de genou LCS[®] (DePuy)⁵
Concepteur : Buechel, Pappas

1985



Implant : Natural Knee[™] I (Sulzer Medica, maintenant Zimmer)^{2,6}
Concepteur : Hoffman

1987



Implant : ORTHOLOC[®] (Wright, désormais MicroPort Orthopedics)³
Concepteur : Whiteside

1988



Implant : Rotaglide®^{8,9}
Concepteur : Wilson

1989



Implant : ADVANTIM® Modular
(Wright, désormais

1990



Implant : AXIOM® (ORTHOMET,
désormais MicroPort
Orthomet, LLC)

1991



Implant : Maxim® (Biomet)¹²
Concepteur : Lombardi, Vaughn

2^{ème} génération: survie de l'implant

1991



Implant : MG II (Zimmer)^{13, 14}
Concepteur : Miller, Galante

1994



Implant : Duracon®
(Howmedica, maintenant
Stryker)^{13, 15}
Concepteur : Borden, Haberman, Hedley,
Hungerford, Krackow

1995



Implant : Natural Knee™ II
(Sulzer Medica, maintenant
Zimmer)¹⁶
Concepteur : Hoffman

1996



Implant : PFC® (DePuy)
Concepteur : Scott, Thorne



Implant : Profix® (Smith & Nephew)¹⁸
 Concepteur : Whiteside



Implant : Scorpio® (Stryker)¹⁹
 Concepteur : Becker, Antonio, Incavo, Lotke

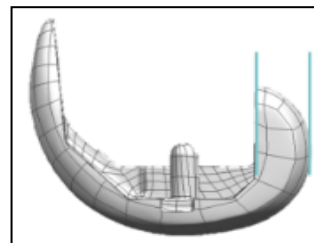
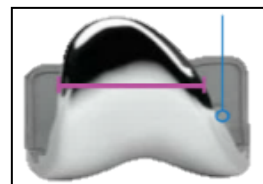


Implant : ADVANCE® Medial-Pivot™²⁰
 Concepteur : Blaha, Maloney, Schmidt



Implant : Ascent™ (Biomet)²²
 Concepteur : Bassett, Jacobs

Garantie de la survie: poly XLPE





Implant : PFC® Sigma Rotating Platform (DePuy)²³
Concepteur : Scott, Thornhill, Callaghan



Implant : NexGen® (Zimmer)²⁴
Concepteur : Walker, Andriacchi, Insall



Implant : Vanguard™ (Biomet)²⁵
Concepteur : Lombardi



Implant : JOURNEY® BCS (Smith & Nephew)²⁶
Concepteur : Smith, Dugas, Cain

- ❖ Poly XLPE, E-poly, poly CPS
- ❖ Titane – Oxynium
- ❖ Augmentation du nombre de tailles
- ❖ Plateaux asymétriques
- ❖ Système « Gender »
- ❖ Système « High flex » :
modification de la CAM, travail des condyles



Implant : Triathlon™ (Stryker)²⁷
Concepteur : Krakow, Hungerford, Savory



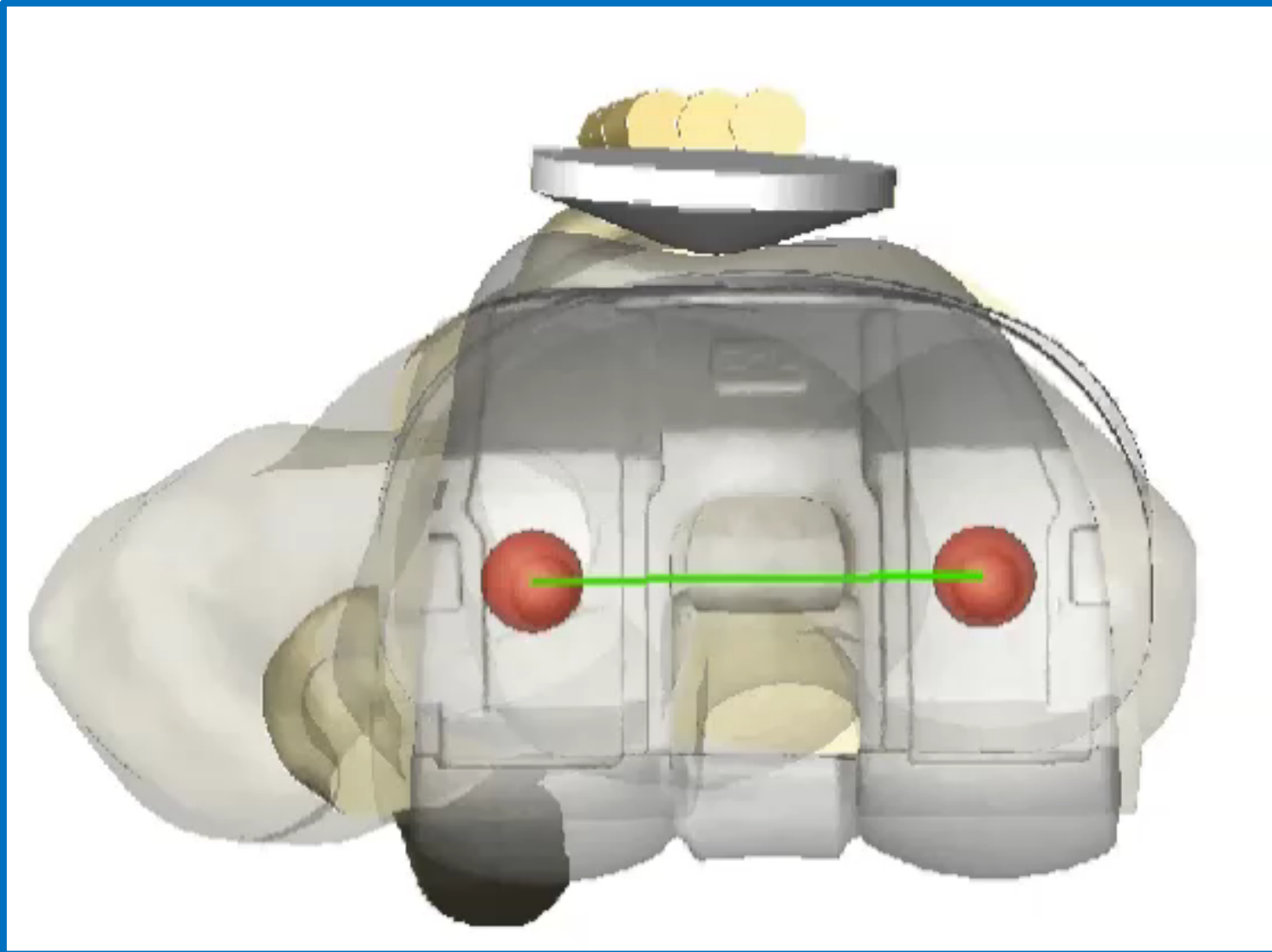
Implant : EVOLV Micro
Concepteur : Ander Malon Jinnah
REMARQUE : Commercialisé uniquement aux États-Unis

Malgré les innovations, maintien d'un niveau d'insatisfaction vers 20%

Pourquoi?

- **Perte de stabilité** : au glissement antérieur de l'implant (« rollbackfront ») et non un roulement postérieur
= mouvement paradoxal
- **Douleur antérieure**: liée au mouvement paradoxal et au tracking rotulien

PTG conventionnelle



- Fémur dans une position **non anatomique postérieure**
Shift **antérieur** en début de flexion (entraînant un *mouvement paradoxal*)
- **Glissement postérieur** bilatéral pour créer le mouvement de flexion.

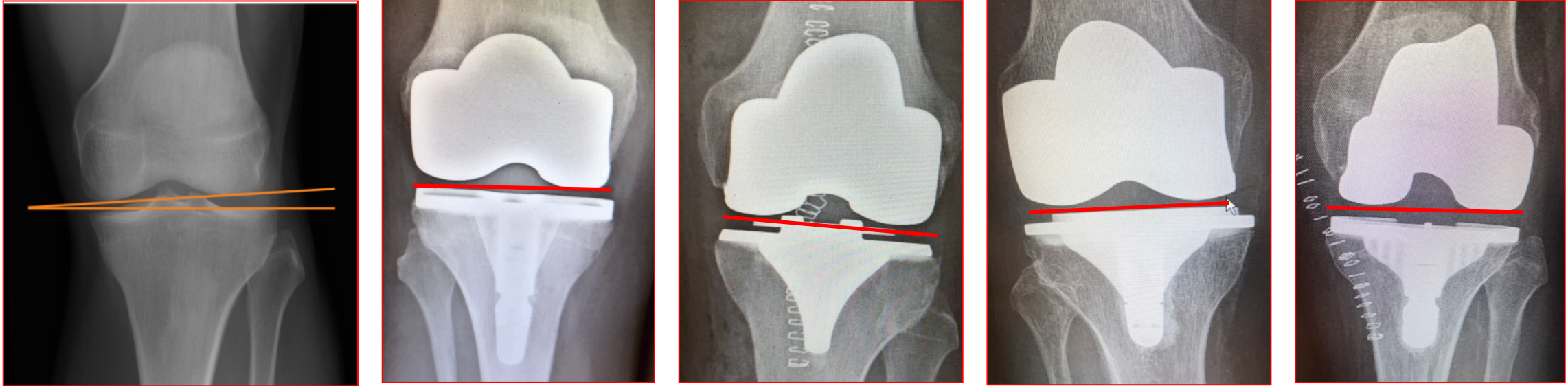
An anatomical illustration of a human lower body, showing the legs and feet. The knees are replaced with a mechanical system called eMP. The background is a blue gradient with a large, faint, stylized eye shape. The text 'eMP' is written in a large, white, serif font in the upper left corner.

eMP™

Evolution®
Medial-Pivot Knee System
The ACL-PCL Substituting Knee™

PTG conventionnelles

Horizontalisation de l'interligne



- Impact sur le **tracking rotulien**.
- **équilibrage ligamentaire nécessaire systématiquement** (needling MCL).

Stabilité de l'implant garantie via l'équilibre ligamentaire et l'effet **CAM**.

> 2000: UNI 

J Arthroplasty. 2019 Aug;34(8):1611-1616. doi: 10.1016/j.arth.2019.04.005. Epub 2019 Apr 8.

Unicompartmental Knee Arthroplasty Provides Significantly Greater Improvement in Function than Total Knee Arthroplasty Despite Equivalent Satisfaction for Isolated Medial Compartment Osteoarthritis

Casper

J Arthroplasty. 2019 Jun 26. pii: S0883-5403(19)30634-5. doi: 10.1016/j.arth.2019.06.043. [Epub ahead of print]

The Combination of Inlay Patellofemoral Arthroplasty and Medial Unicompartmental Knee Arthroplasty Versus Total Knee Arthroplasty for Mediopatellofemoral Osteoarthritis: A Comparison of Mid-Term Outcomes

Uluyardimci E¹, Isik C², T

Acta Orthop Belg. 2018 Sep;84(3):237-244.

Bi-unicompartmental versus total knee arthroplasty: long term results.

Biazzo A, Manzotti A, Confalonieri N.

Pourquoi un tel succès de l'UNI?

J Arthroplasty. 2014 Jan;29(1):48-51. doi: 10.1016/j.arth.2013.04.024. Epub 2013 May 18.

Joint awareness in different types of knee arthroplasty evaluated with the Forgotten Joint score

Thienpont E¹, C

Knee Surg Sports Traumatol Arthrosc. 2017 Mar;25(3):681-686. doi: 10.1007/s00167-015-3868-1. Epub 2015 Nov 21.

Unicompartmental knee arthroplasty versus total knee arthroplasty: Which type of artificial joint do patients forget?

Zuiderbaan H J Arthroplasty. 2017 May;32(5):1453-1459. doi: 10.1016/j.arth.2016.11.034. Epub 2016 Nov 27.

Differences in Patient-Reported Outcomes Between Unicompartmental and Total Knee Arthroplasties: A Propensity Score-Matched Analysis.

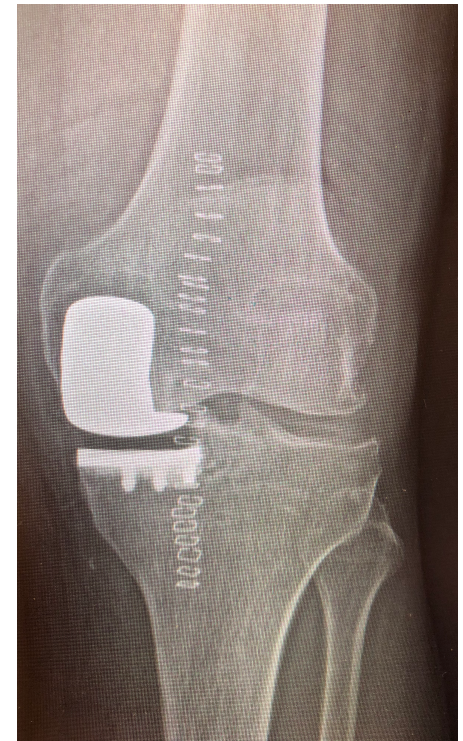
Kim M

RESULTS: One-hundred and thirty patients were included. Sixty-five patients underwent medial UKA and 65 patients underwent TKA. At both follow-up points, the FJS was significantly higher in the UKA group (FJS 1 year 73.9 ± 22.8 , FJS 2 year 74.3 ± 24.8) in contrast to the TKA group (FJS 1 year 59.3 ± 29.5 ($p = 0.002$), FJS 2 year 59.8 ± 31.5 , ($p = 0.004$)). No significant improvement in the FJS was observed between 1- and 2-year follow-up of the two cohorts.

CONCLUSION: Patients who undergo UKA are more likely to forget their artificial joint in daily life and consequently may be more satisfied.



Chirurgie de resurfaçage



Maintien du pivot central et ainsi la cinématique
d'un genou normal

Cinématique normale

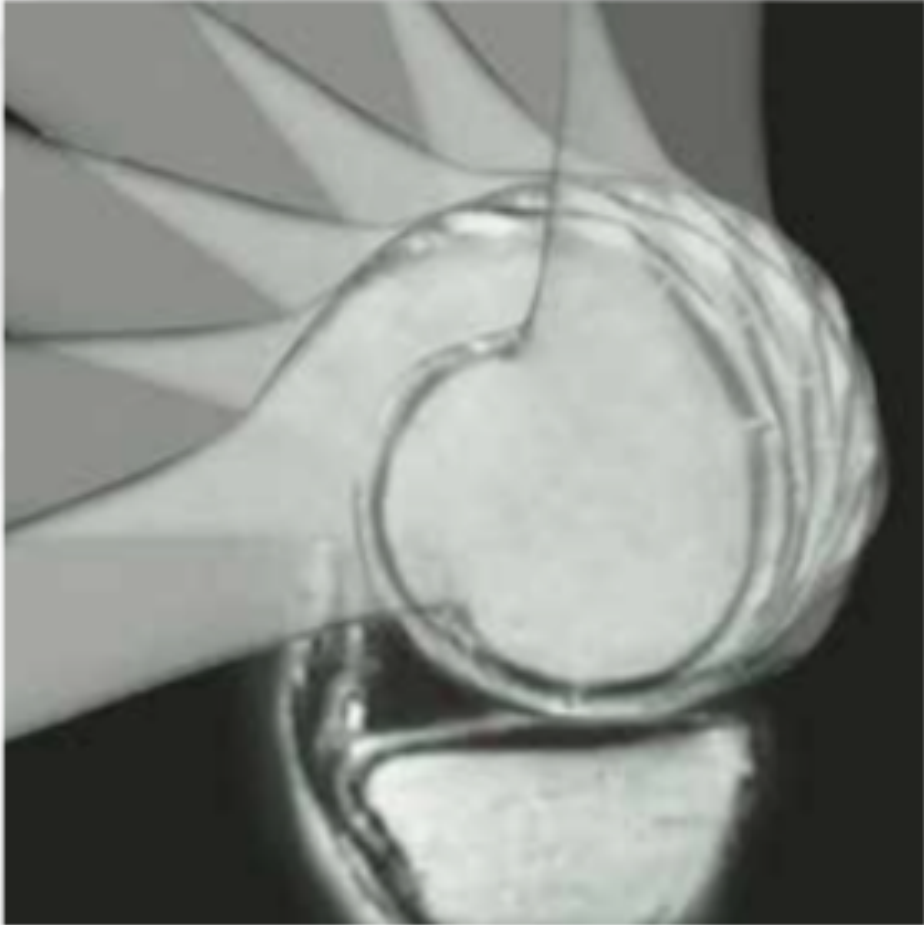


FIGURE 1 | Compartiment interne

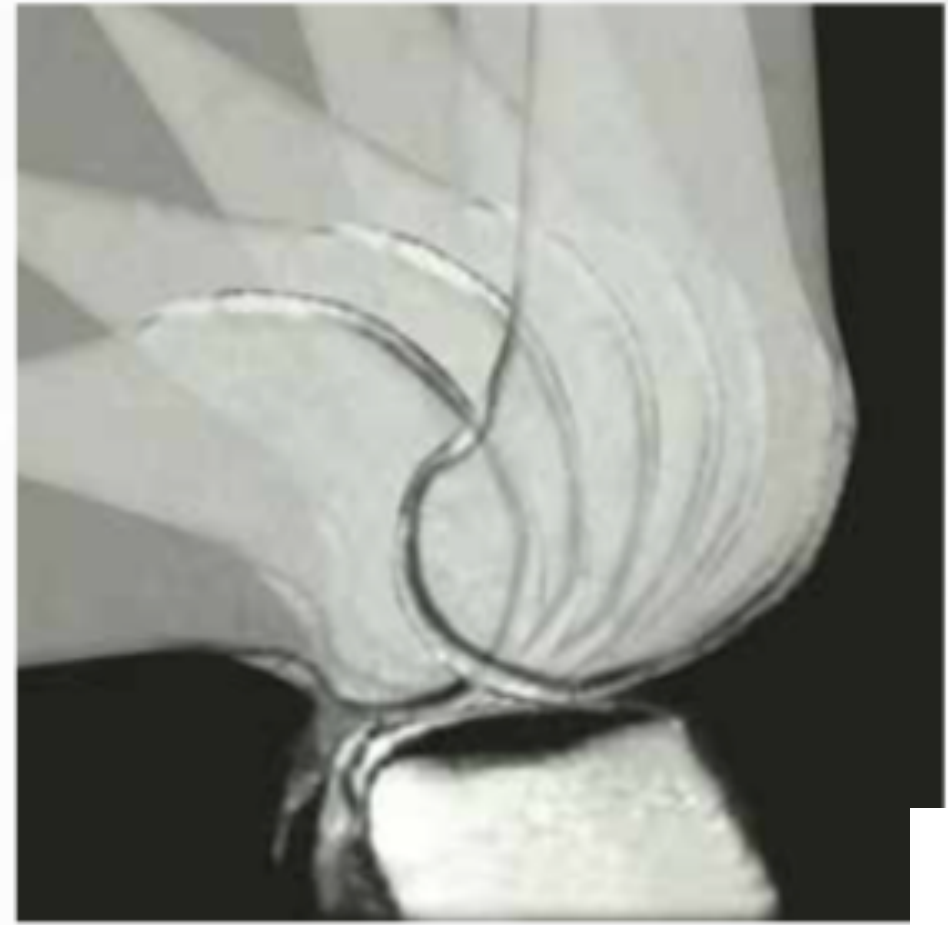


FIGURE 2 | Compartiment externe

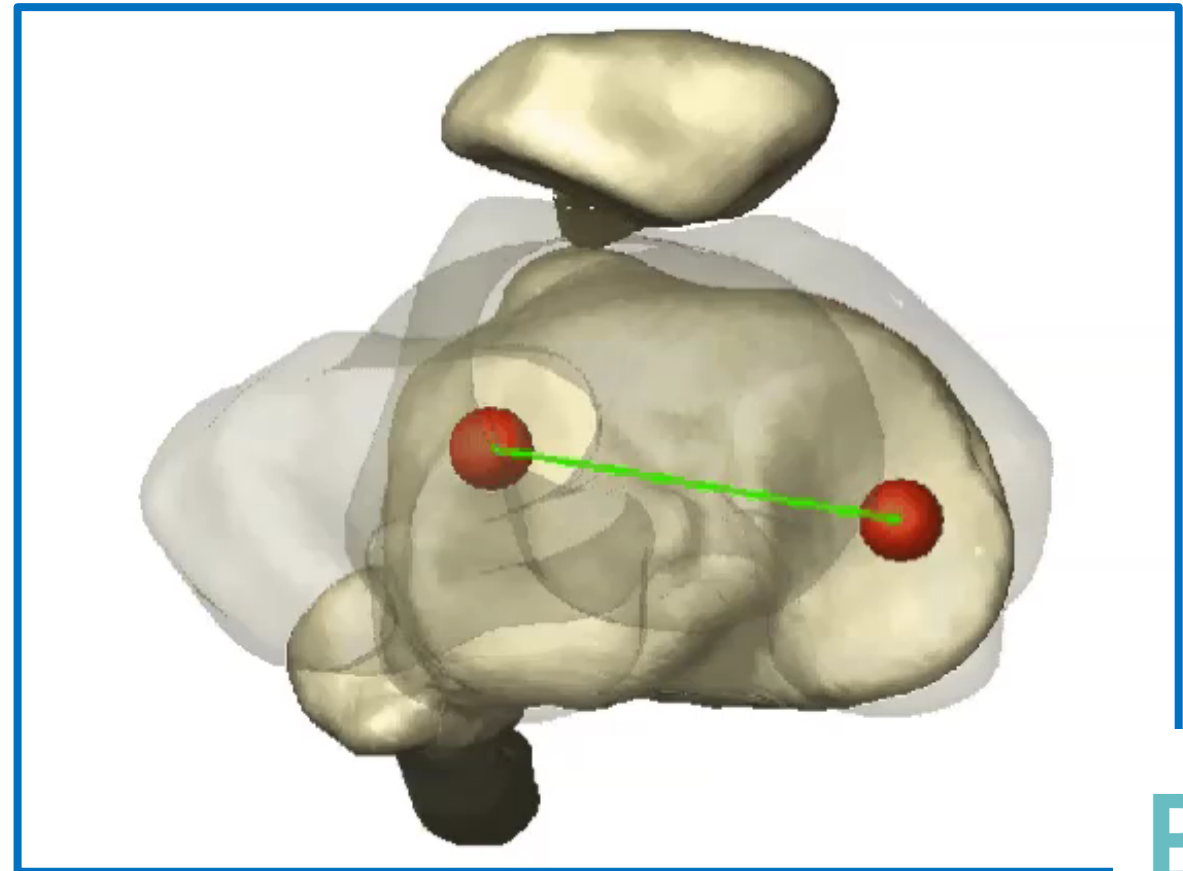
1-90° (Mid Flexion)

- Medial pivot
- Translation post latérale (Q angle ~ 0)
- Augmentant l'efficacité du quadriceps



90-155° (Full Flexion)

- Translation Posterior femoral
- Conservation de la rotation axiale
- Translation qui aide l'hyperflexion et l'efficacité du quad



Autre aspect anatomique = Obliquité de l'interligne:

→ impact sur la tension ligamentaire et le tracking rotulien



Création des PTG nouvelle génération (3^{ème})

- But = Reproduction de la **biomécanique naturelle** du genou
1. Contrôle du **mouvement paradoxal** lié à la perte de congruence articulaire mais aussi du pivot central
 2. Contrôle de **l'instabilité**
 3. Amélioration du **Tracking rotulien**
 4. Tenir compte de **l'offset rotulien** (encombrement antérieur)

Prothèses « nouvelle génération »

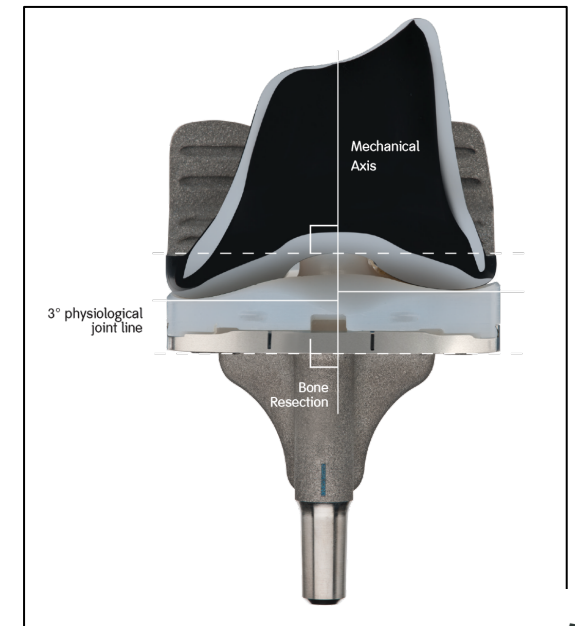
PTG XR



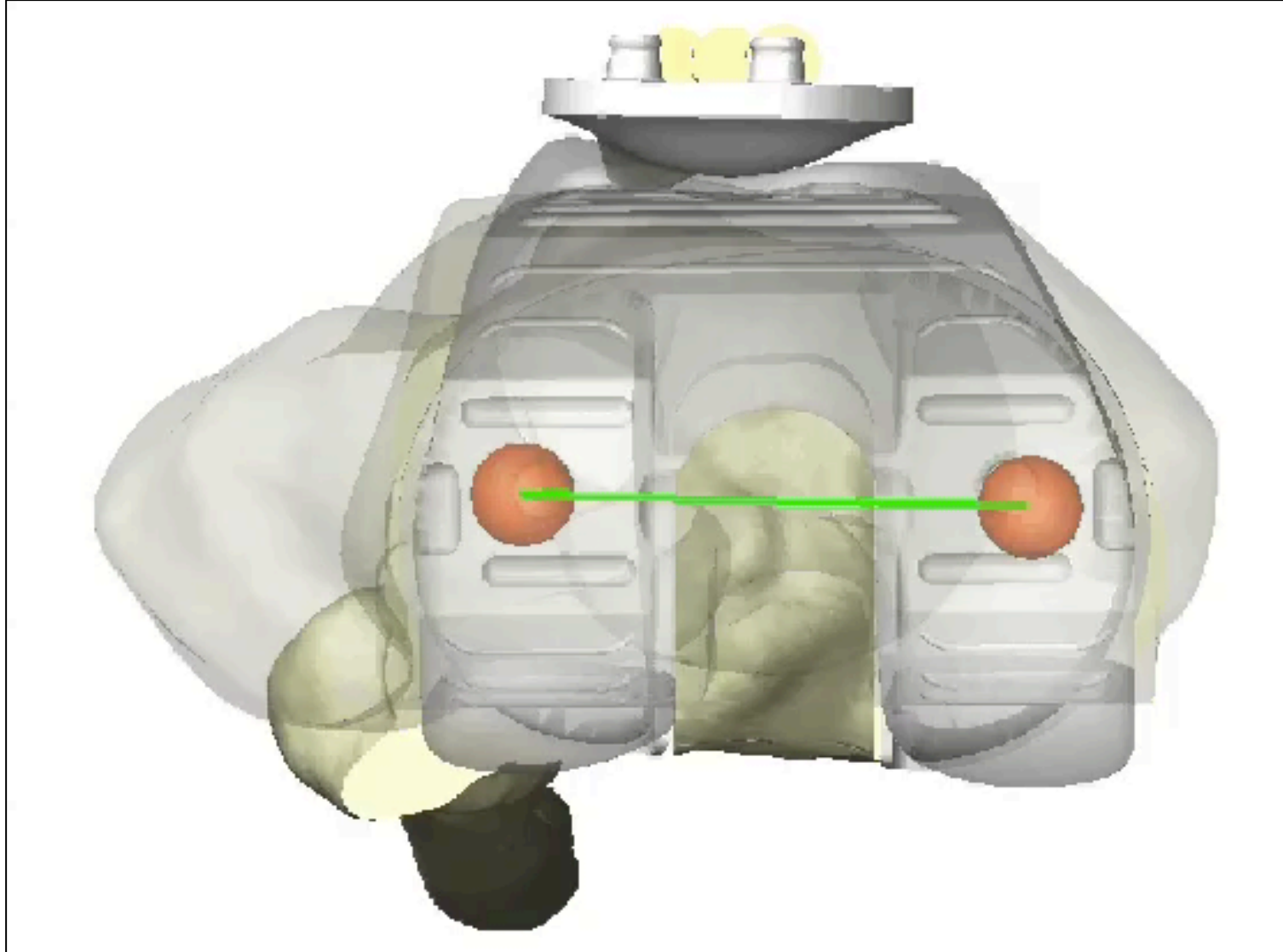
PTG médial pivot



Journey II BCS

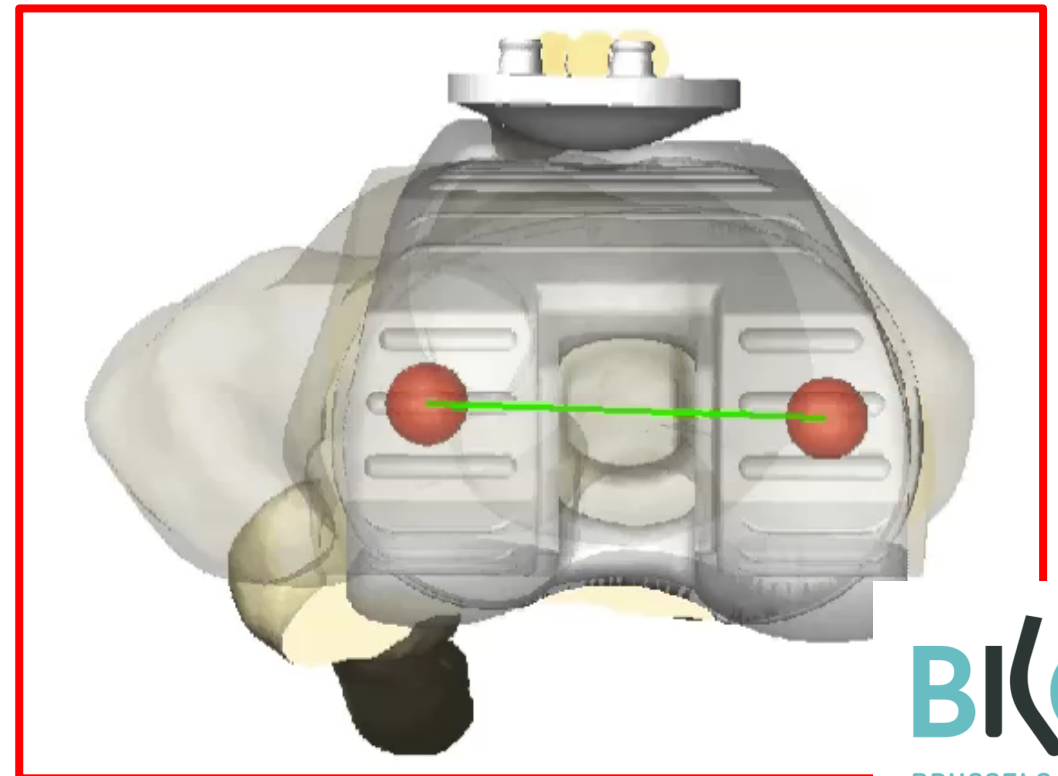


Implant XR

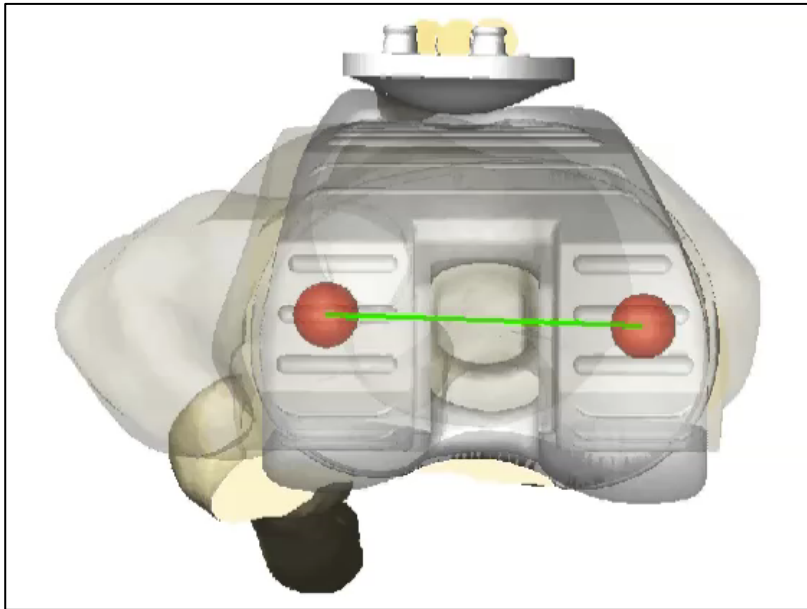


Biomécanique PTG nouvelle génération: Journey II

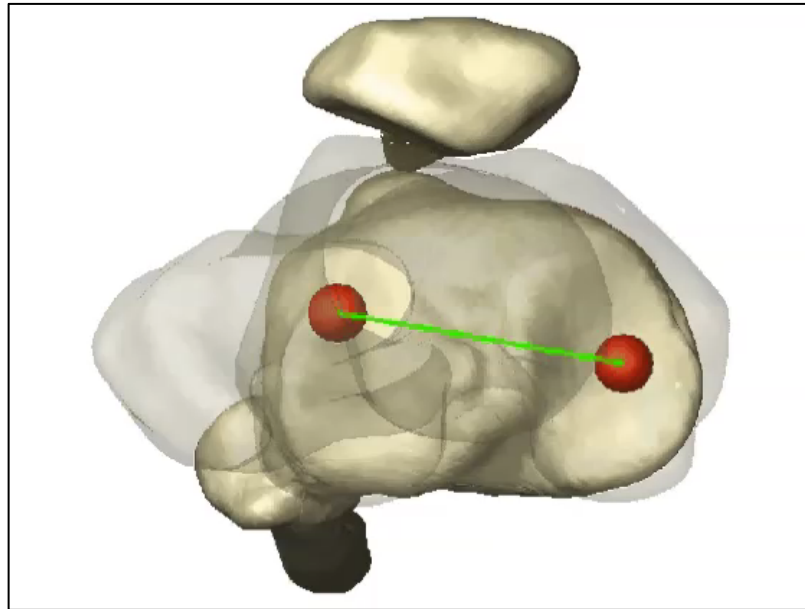
- Médial pivot + CAM
- Bombement du plateau externe
- Obliquité de 3° de l'interligne articulaire
- Flexion importante (coupe post)



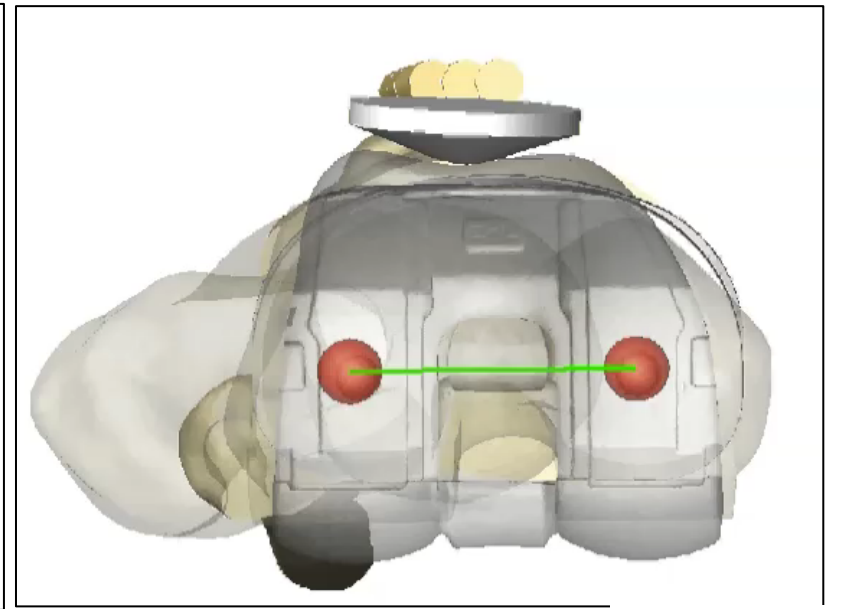
Comparaison de la Cinématique



Journey II



Naturel



PTG conventionne

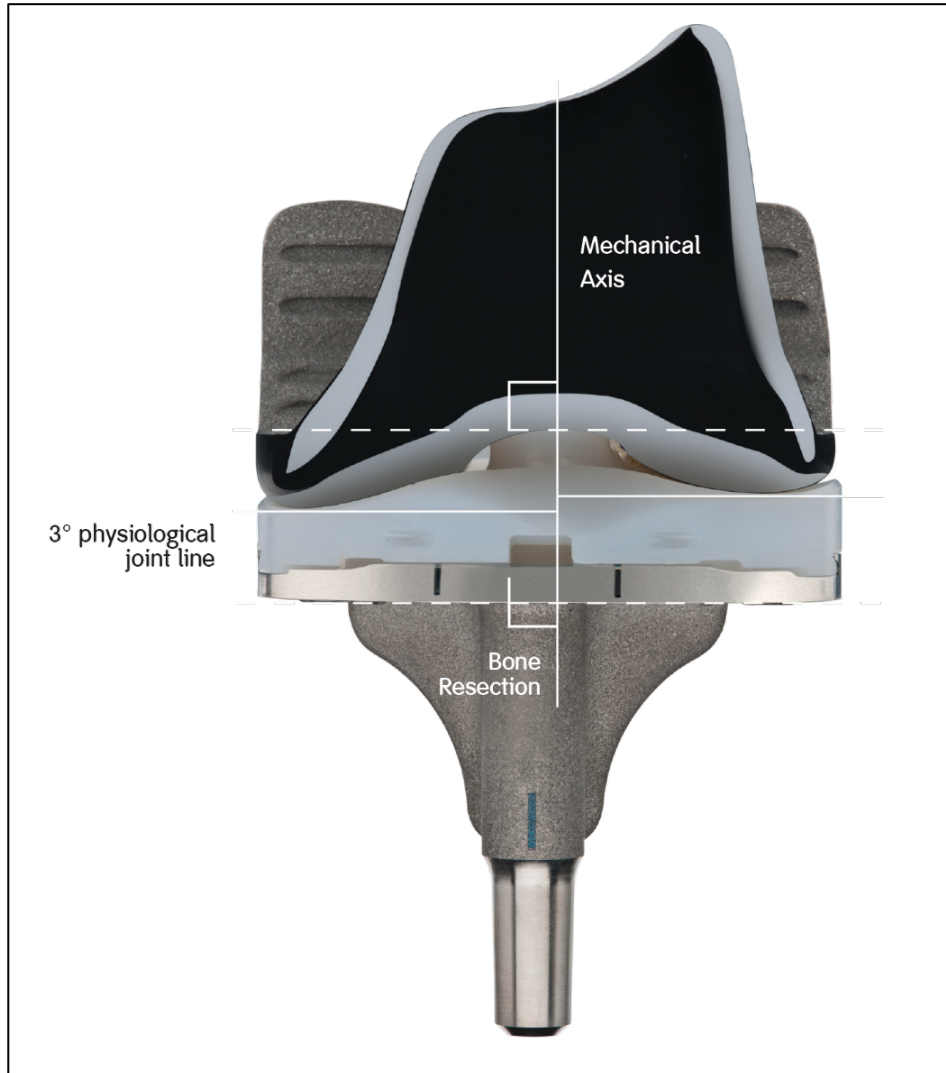
L'obliquité articulaire

- Un interligne articulaire asymétrique

Normal A/P Position

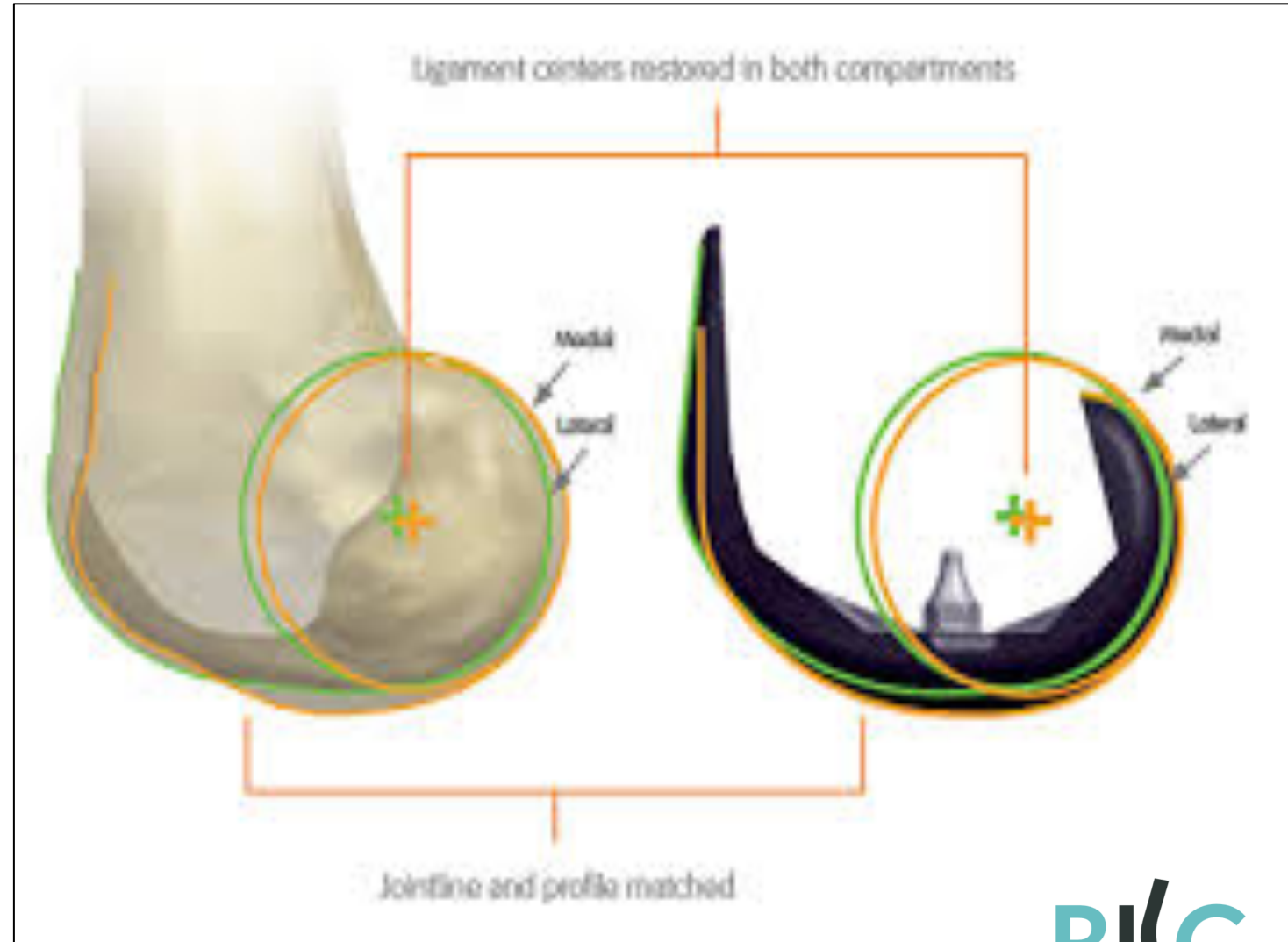


- 3°
- Meilleure **tension ligamentaire** (plus proche de la normale)
- Effet direct sur le **tracking rotulien**

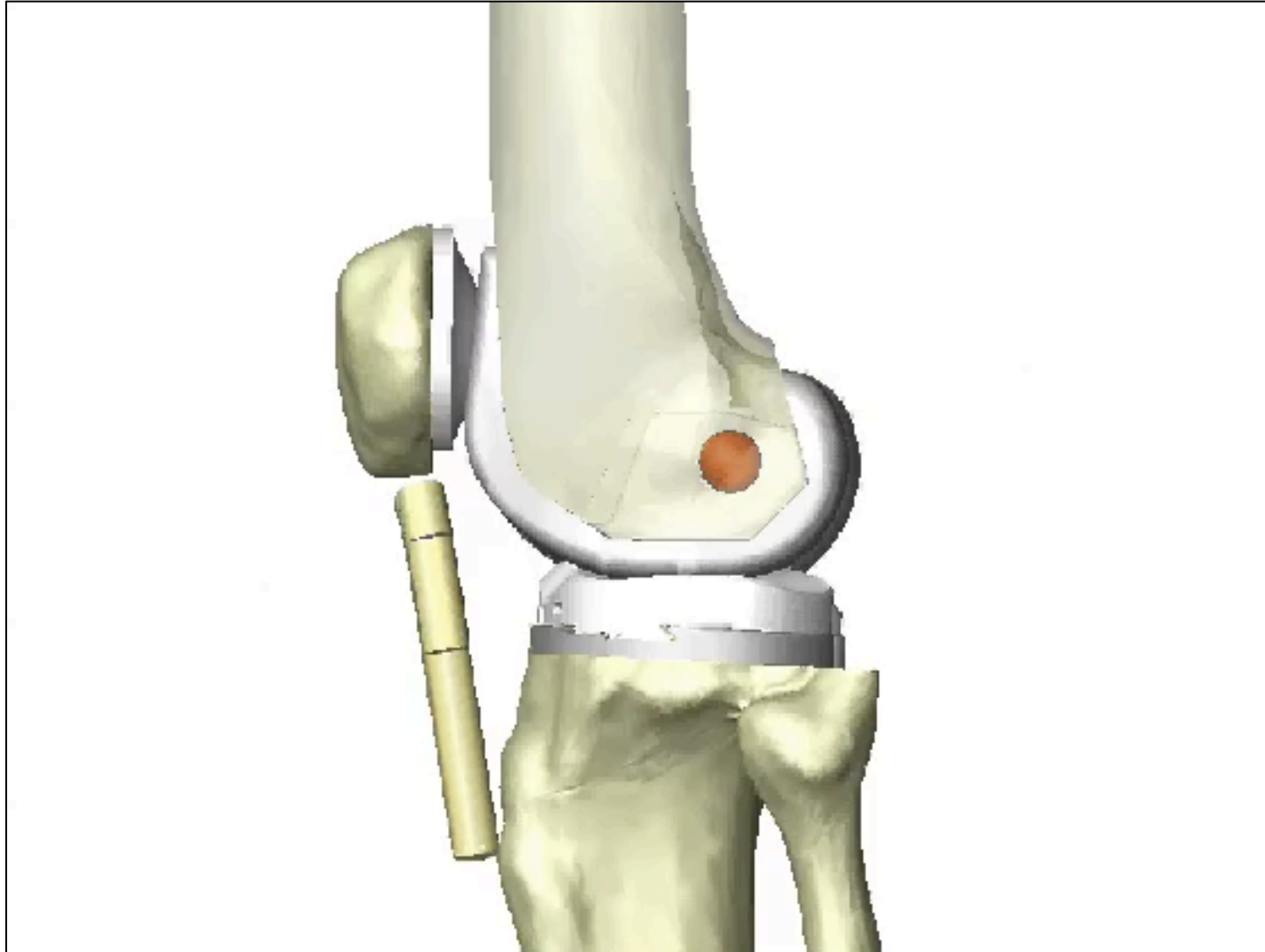


- Maintien des centres ligamentaires (single radius)
- Maintien offset post et antérieur

Hyperflexion 155°
Coupe post de 15°

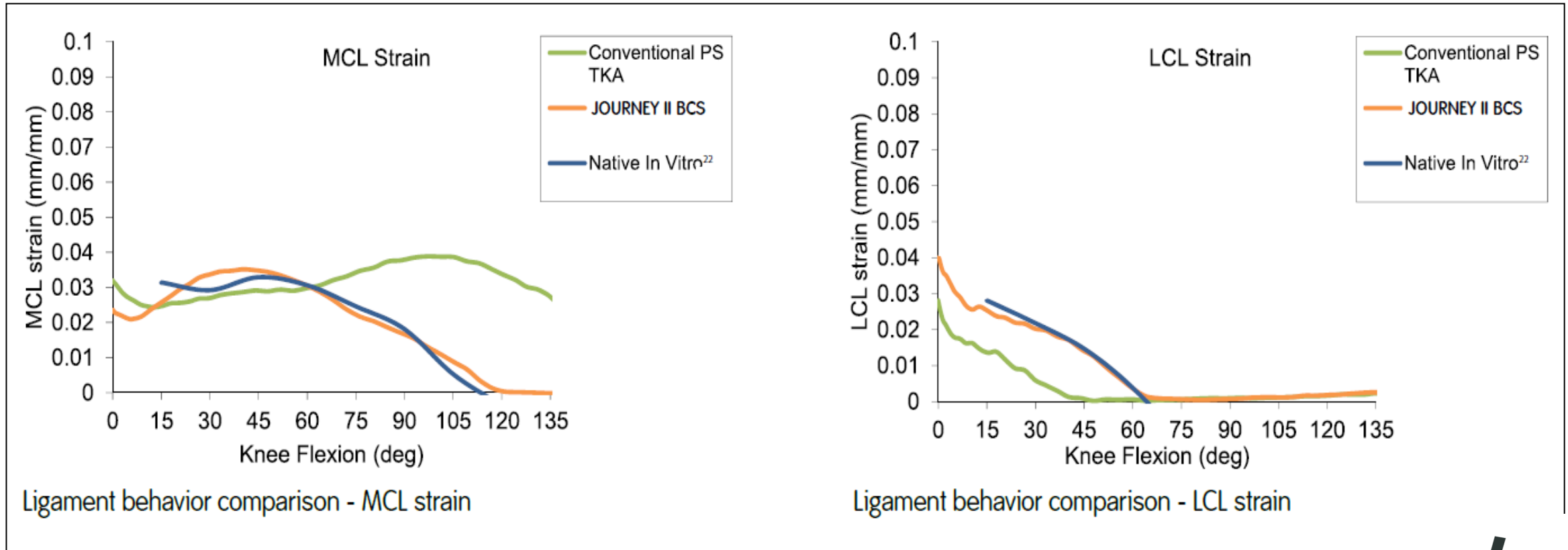


Hyperflexion



Tension ligamentaire normale

Effets du design sur les ligaments:



K09-JRN2 KneeSim Analysis RevA
Harfe DT, et al. *Clinical Biomechanics*. 1998;13(3):163-175.

Encombrement antérieur



Int Orthop. 2014 Feb;38(2):227-33. doi: 10.1007/s00264-013-2245-2. Epub 2014 Jan 14.

Design and kinematics in total knee arthroplasty.

Digennaro V¹, Zambianchi F, Marcovigi A, Mugnai R, Fiacchi F, Catani F.

CONCLUSIONS: Journey BCS showed statistically significant better KOOS results. The higher posterior femoral rollback observed in the kinematic assessment of this design, associated with a better patellofemoral design, may be the reason for better clinical outcome. The reported cases of stiffness and anterolateral joint pain could be attributed to excessive medial and lateral tibiofemoral posterior translation. The NRG group demonstrated good axial rotation, but this was not coupled with physiological kinematic patterns. Patellofemoral pain can be explained by a less friendly femoral-groove design. TKA clinical-functional outcome and complications were highly influenced by the bearing geometry and kinematic pattern of prosthetic designs.

Evidence in focus

Study summary

Iriuchishima T, Ryu K. *J Knee Surg* (2017)*



Supporting healthcare
professionals for over 150 years

JOURNEY® II BCS restores function comparable to bicruciate retaining Oxford Unicompartmental Knees (UKA)

The bicruciate stabilising design reproduces anterior and posterior cruciate ligament function and native knee rollback



Study design

A single-surgeon retrospective study comparing outcomes at 6–9 months follow-up of patients treated with:

- JOURNEY II BCS: n=64 patients (mean age, 71.3 years $\pm$ 7.2 years)
- UKA: n=50 patients (mean age, 73.8 years $\pm$ 6 years)
- Control group: contralateral asymptomatic knees of subjects with UKA



Key results

Post-operative lateral knee radiograph (full flexion) showed:

- No significant difference in rollback ratio or knee flexion angle among the three groups (Table 1)
- Significant correlation between rollback ratio and knee flexion angle among the three groups ($p=0.002$) (Table 1)

	JOURNEY II BCS	UKA	Control
Rollback ratio %, mean (standard deviation)	37.9 ($\pm$ 4.9)	35.7 ($\pm$ 4.2)	35.3 ($\pm$ 4.8)
Flexion angle degrees, mean (standard deviation)	123.8 ($\pm$ 8.4)	125.4 ($\pm$ 7.5)	127 ($\pm$ 10.3)

Table 1. Rollback ratio and flexion angle measurement



Conclusion

- JOURNEY II BCS showed no significant difference in rollback ratio when compared with UKA or asymptomatic control knees.
- The implant design is likely to reproduce native anterior and posterior cruciate function and native knee rollback.



Considerations

- Pre-operative evaluation of rollback ratio and knee flexion was not performed



Study citation

*Iriuchishima T, Ryu K. A Comparison of Rollback Ratio between Bicruciate. Substituting Total Knee Arthroplasty and Oxford Unicompartmental Knee Arthroplasty. *J Knee Surg*. 2017 Jul 25. [Epub ahead of print]



64 JOURNEY™ II BCS vs 50 UKA vs 50 Healthy Knees

- No significant difference in rollback ratio or ROM among 3 groups
- Significant correlation between rollback ratio and ROM
- JOURNEY II BCS is likely to reproduce

Iriuchishima et al.

Etudes

Rééducation plus douce

Nodzo, Mayman et al.

23° ROM improvement at 1-year follow-up vs standard PS design.¹

Kaneko et al.

Provides medio-lateral stability in the mid-flexion range and reproduces the **same medial pivot as normal knees**, aiding in patient recovery.²

Harris et al.

Significant improvements in patient-reported KSS and movement-associated pain at 24 months post-TKA.³

Mayman et al.

JOURNEY™ II BCS associated with **significantly reduced total hospital cost, less likely to have 30 days readmission and significantly reduced hospital stays** compared with other total knee arthroplasty (TKA) systems.⁴

Amélioration de la fonction

Hommel et al.

Significant improvements over baseline in Knee Score, Function Score and range of motion (ROM) with **patients averaging 127° ROM**.⁵

Iriuchishima et al.

Restores function comparable to bi-cruciate retaining Oxford Uni Knees (UKA).⁶

Grieco, Komistek et al.

Exhibits normal-like knee kinematic patterns suggesting the dual cam-post design and asymmetric articular geometries **adequately replicate ACL and PCL function**.⁷

Satisfaction patient majorée

Nodzo, Mayman et al.

Significantly better KSS scores than **standard PS** designs at one year follow-up, resulting in **reducing patient dissatisfaction**.¹

Kaneko et al.

Reduces medio-lateral instability in mid-flexion and **improve patient satisfaction**.²

Harris et al.

Increased patient satisfaction scores from 33 at 6-month follow-up to 35 at 24-month follow-up.³

¹ Nodzo SR, et al. *Tech Orthop*. 2018;33:37-41.

² Kaneko T, et al. *J Orthop*. 2017;14(1):201-206.

³ Harris AI, et al. *Arthroplasty Today*. 2018;4(2):240-243.

⁴ Mayman DJ, et al. Poster presented at: ISPOR Symposium; May 19-23, 2018; Ba

⁵ Hommel H, et al. *The Open Orthopaedics Journal*. 2017; 11:51-56.

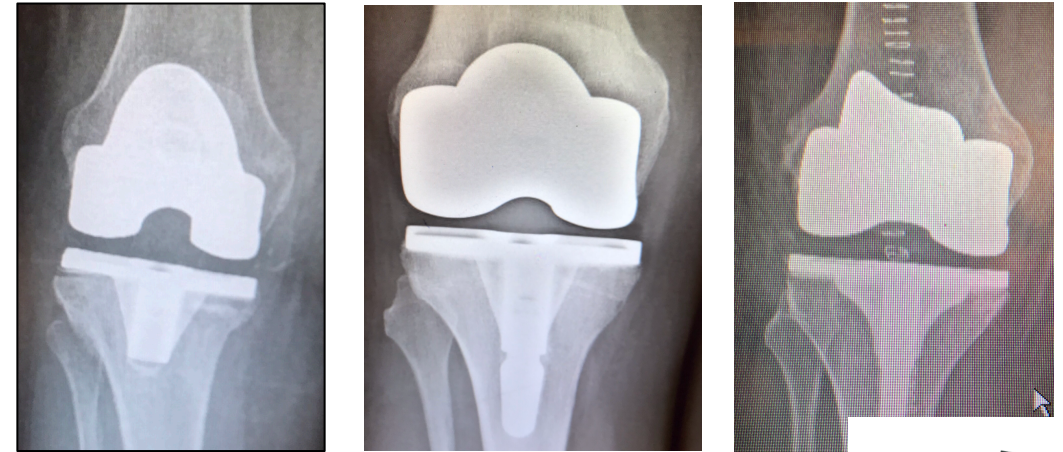
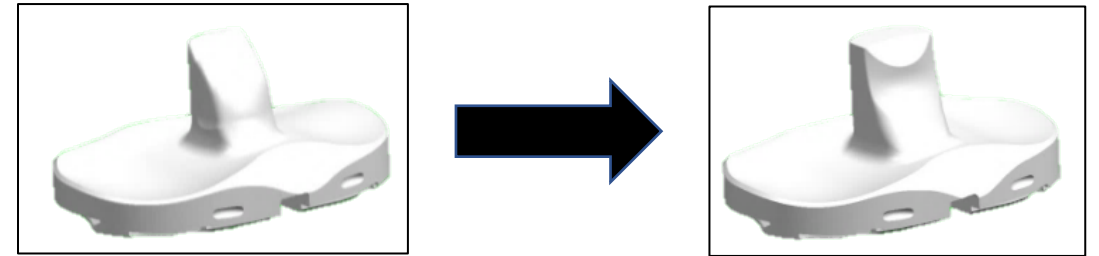
⁶ Iriuchishima T, et al. *The Journal of Knee Surgery*. 2018;31(6):568-572.

⁷ Grieco TF, et al. *The Journal of Arthroplasty*. 2018;33(2):565-571.

Contrôler les causes de complications

Nécessité d'un portefeuille d'implant complet.

- **Instabilité** sur insuffisance ligamentaire: poly PS vers **CPS**
- **Descellement précoce (Lift off)** du tibia: ancrage métaphysaire plus important (tige plus longue 3cm)
- **Allergie:** Oxinium ou Titane



JOURNEY™ II TKA: portefeuille implant complet

Femur/Tibia

XR

CR

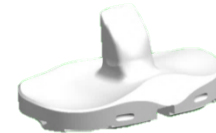
BCS

Revision

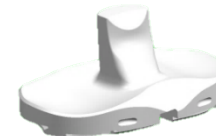
10 AP Sizes
Same AP Box



Kinematic
Options



Constrained
Options



Seamless
Primary ->
Revision



8 anatomic sizes
(L/R)

9 anatomic sizes
(L/R)

9 anatomic sizes
(L/R)

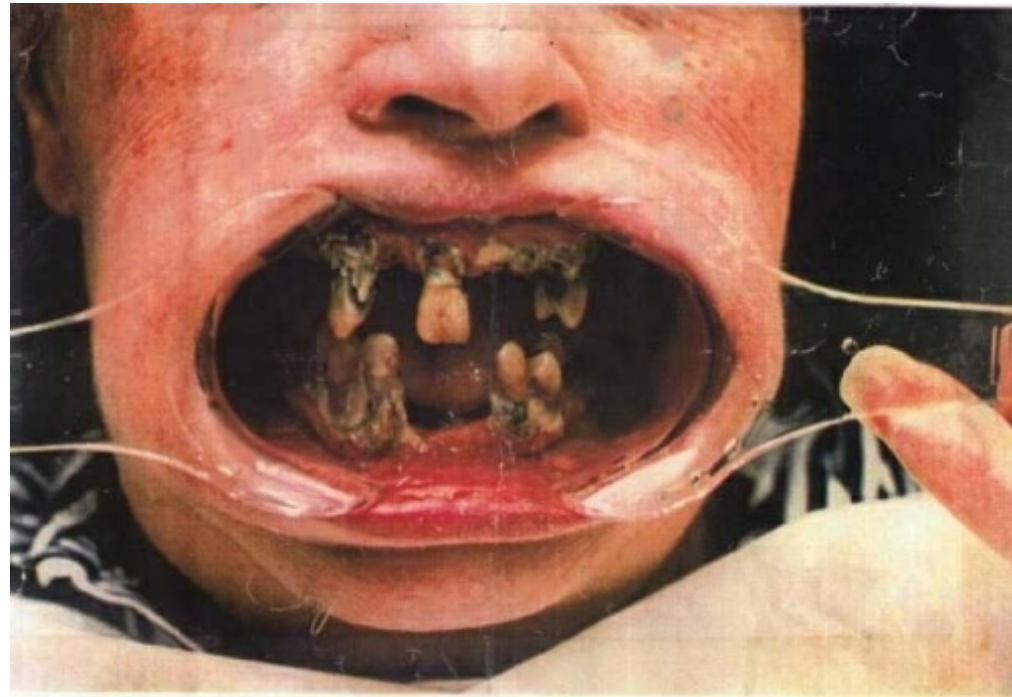
Primary Stem
Options

Revision Stem
Options

Dernier message:

- Nouvelle génération prometteuse

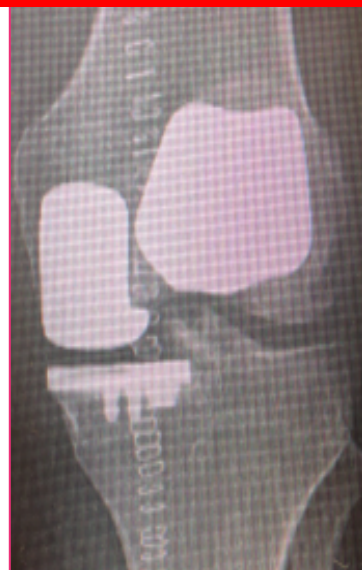
Mais Toute arthrose $\neq$ PTG







Chirurgie sur mesure



Merci

