

Dual mobility arthroplasty

Mohamad parhamfar

*(**THA**) is one of the most successful surgical procedures – reducing pain and providing functional improvement to enhance patients' quality of life*

***instability** is a disabling condition and remains the **most** common indication for revision THA in the United States*

high-risk neuromuscular disease, obesity or cognitive dysfunction

***cost** of revision often exceeding 50,000 US*

- **Gilles Bousquet** and André Rambert introduced the concept of dual mobility (DM) in France in 1974
- widespread use of the DMC was limited due to concerns regarding accelerated **wear** of the polythene acetabular liner
- the nature of dual articulation causing unique complication of intraprosthetic dislocation (**IPD**)
- United States Food and Drug Administration's approval of the DM design in **2009**, use of DM has undergone a renaissance in recent year



First-generation DM

- *hemispherical stainless-steel acetabular socket with an **alumina** coating and an inner polished surface*
- *anchored with two stainless-steel pins pressed into two holes in the socket and a 4.5 mm screw inserted through a clip into the ilium*
- *The mobile outer head was constructed from ultra-high molecular weight **polyethylene** (PE) and the inner femoral head was **metal***
- ***vice clamp** was used to force the inner femoral head into the outer head and beyond its PE retentive rim*



- *The inner femoral head is dominant during normal ranges of motion
outer PE head is dominant during high ranges of motion – explaining
the term ‘**dual mobility**’*
- *reducing the risk of dislocation by facilitating an increased range of
movement before impingement and maximizing the **jump distance**
needed for the femoral head to separate from the acetabular socket*

Jump distance

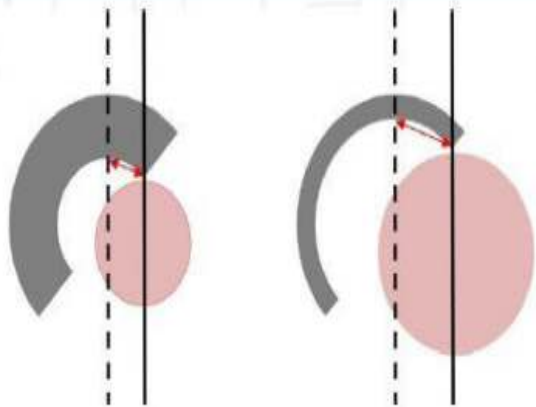
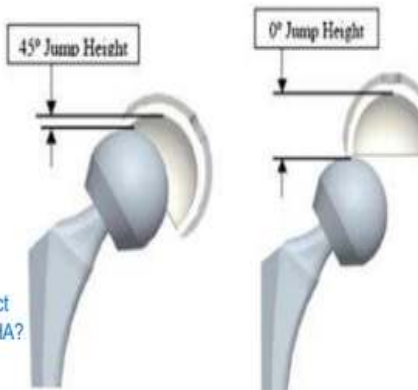


Figure 3. Jumping Distance highlighted by red arrow demonstrates distance the head needs to travel before dislocation occurs. Increasing head size increases this distance.

- Jump distance:
 - is lowered by cup inclination (0,25 mm per 1° with 32 mm head diameter)
 - is increased by cup anteversion (0,05 mm per 1°)
 - is increased by head diameter (0,4 mm per 1 mm of head diameter when inclination is 45°)



Nevelos J I wsp. What Factors Affect Posterior Dislocation Distance in THA? Clin Orthop Relat Res (2013) 471: 519–526



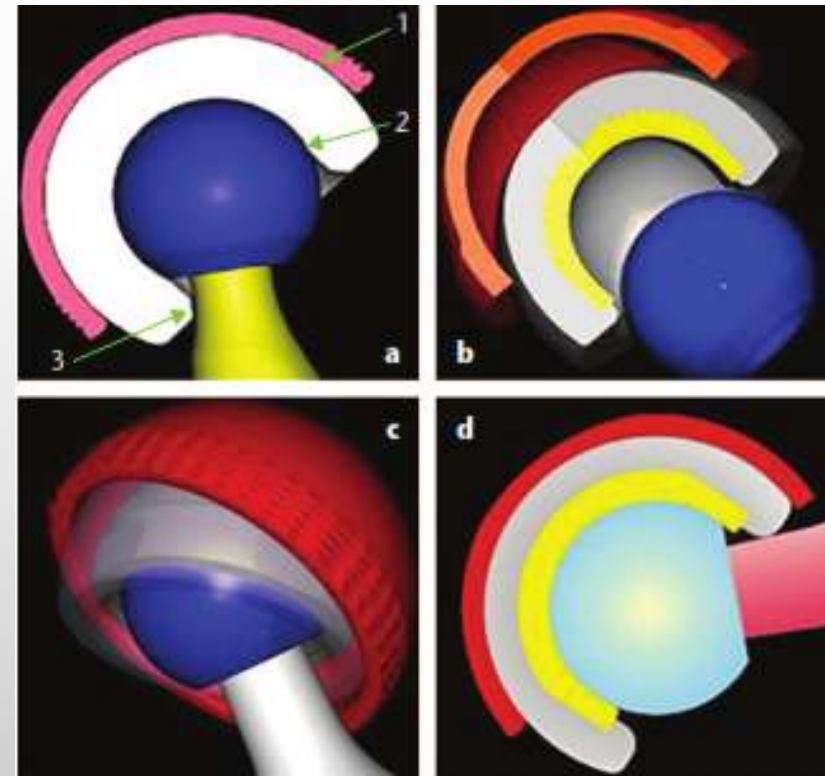
Dual mobility hip design

- *DM design consists of a small femoral head (22 or 28mm)*
- *polyethylene large head diameter is usually 6–8 mm smaller than the size of the outer metallic shell*
- **small** articulation head and the PE liner
- **large** articulation polyethylene head and the acetabular shell.

majority of movement small articulation

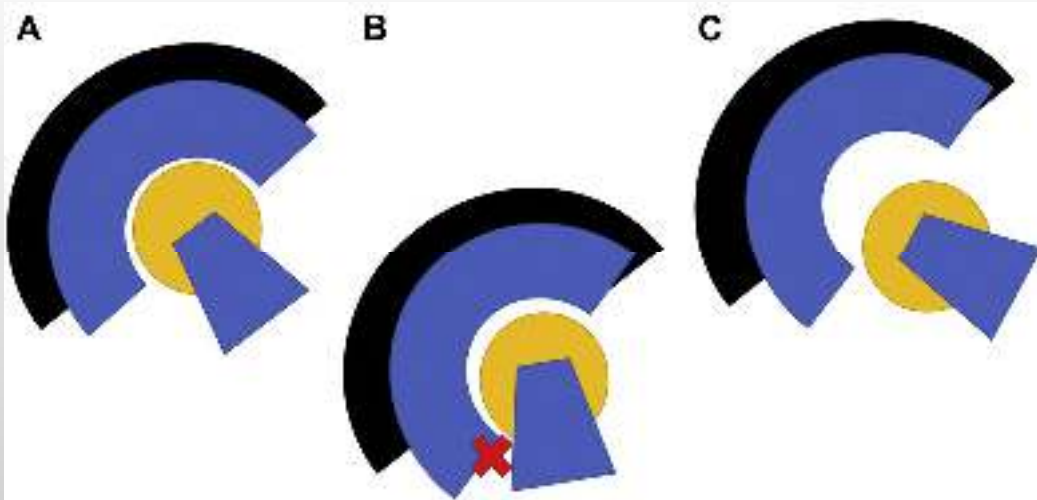
large articulation neck comes into contact with PE

Wear { *small*
large
neck–polyethylene contact area (third articulation)



'Intraprosthetic dislocation' (IPD)

- dissociation of the outer PE head from the inner femoral head secondary to degeneration of the PE retentive rim
- C-shaped *bubble* on plain radiographs
- metal-on-metal articulation (rapid wear-*metalosis*)
- acute limb shortening
- pain



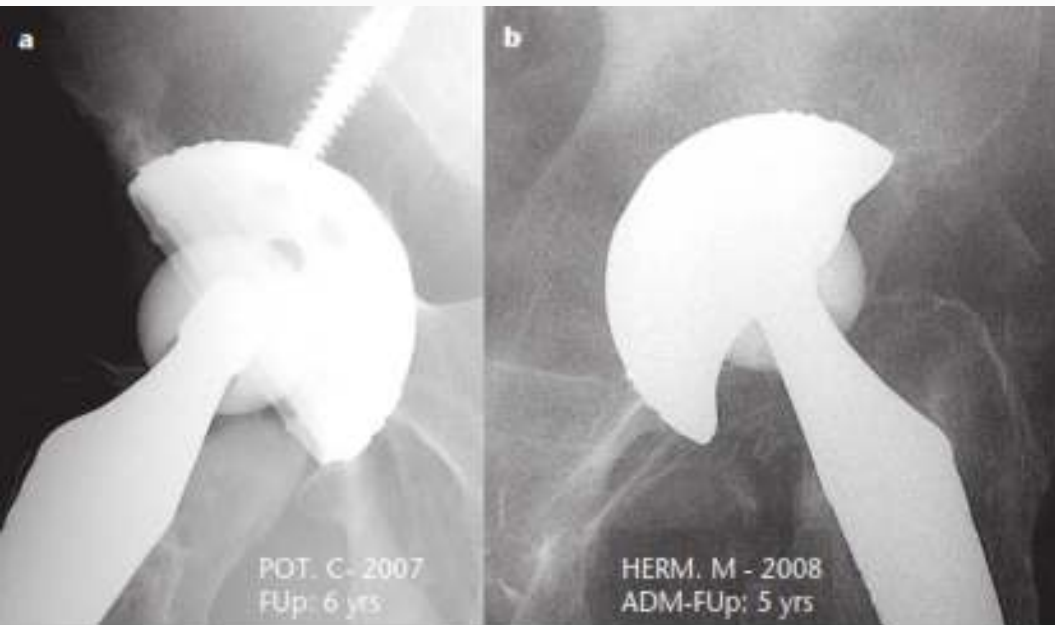
Contemporary DM

- *more anatomic cup which reduces anterior overhang*
- **PE** modified via addition of a retentive chamber to decrease the risk of dislocation,
- *femoral neck has become thinner and more polished to reduce liner impingement*
- *bilayer of porous titanium and hydroxyapatite (instead of alumina)*
- *highly cross-linked, durable PE rim, minimizing wear during contact with the femoral neck*



modern' dual mobility (DM) cup

- *to avoid a planeing effect between the polyethylene head and the metallic shell rim, the articulating surface should be supra-hemispheric (coverage angle of > 180 degrees)*
- *These improvements in the prosthetic design should bring an end to the complications reported in the early ages of DM.*



DM versus standard bearing in primary THA


- *excellent short and mid-term results compared to standard bearing implants in primary THA*
- ***Epinette** established a statistically significant difference in dislocation rate favouring DM (0% versus 5.4%)*
- *Much of the literature on DM is based in **France***
- ***Chicago**, Haughom et al (2016) dislocation rates (0.5% versus 4.5%) anatomic head sizes vs standard bearings 36 mm head*
- *Hernigou et al **obese** (BMI 30 > kg/m²)*
 - 7 years follow-up*
 - dislocation DM or constrained (2%) standard bearing cup (9%)*
 - bariatric surgery prior to THA*

DM versus standard bearing in primary THA

- *cerebral palsy or other neurologic diseases*
 - coxa valga*
 - increased femoral anteversion*
 - imbalanced adductor, internal rotator and hip flexor*
- *Sanders et al no dislocations in 11 DM THA for CP (39 months)*
- *Morin et al no aseptic loosening or dislocations in 40 CP (5 years)*

DM in neck of femur fractures (NOFs)

- *arthroplasty is the treatment of choice for displaced **fragility** neck of femur fractures (NOFs)*

- *Hemiarthroplasty* 
 - shorter operative times*
 - perioperative blood loss*

National Institute for Health and Care Excellence (NICE) currently advise THA rather than hemiarthroplasty (HA) in cognitively unimpaired patients able to independently mobilize outdoors with no more than the use of a stick

THA in NOFs instability secondary to a combination of muscular insufficiency and propensity for recurrent falls

Repeat dislocations represent a life-threatening complication.



■ SYSTEMATIC REVIEW

Dual mobility total hip arthroplasty in the treatment of femoral neck fractures

SYSTEMATIC REVIEW AND META-ANALYSIS

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Aims

To evaluate the rate of dislocation following dual mobility total hip arthroplasty (DM-THA) in patients with displaced femoral neck fractures, and to compare rates of dislocation, surgical-site infection, reoperation, and one-year mortality between DM-THA and bipolar hemiarthroplasty (BHA).

Methods

Studies were selected based on the following criteria: 1) study design (retrospective cohort studies, prospective cohort studies, retrospective comparative studies, prospective comparative studies, and randomized controlled studies (RCTs)); 2) study population (patients with femoral neck fracture); 3) intervention (DM-THA or BHA); and 4) outcomes (complications during postoperative follow-up and clinical results). Pooled meta-analysis was carried out to evaluate the dislocation rate after DM-THA and to compare outcomes between DM-THA and BHA.

• *conclusion*

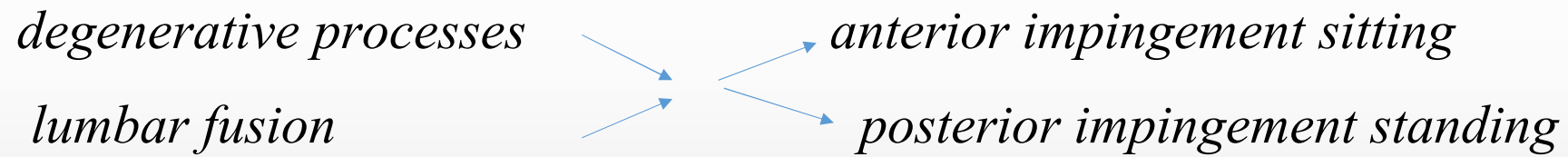
while the evidence available consisted mainly of non-randomized studies, DM-THA

*appeared to be a viable option for patients with displaced fractures of the femoral neck, with better reported rates of **dislocation**, **reoperation**, and **mortality** than BHA.*

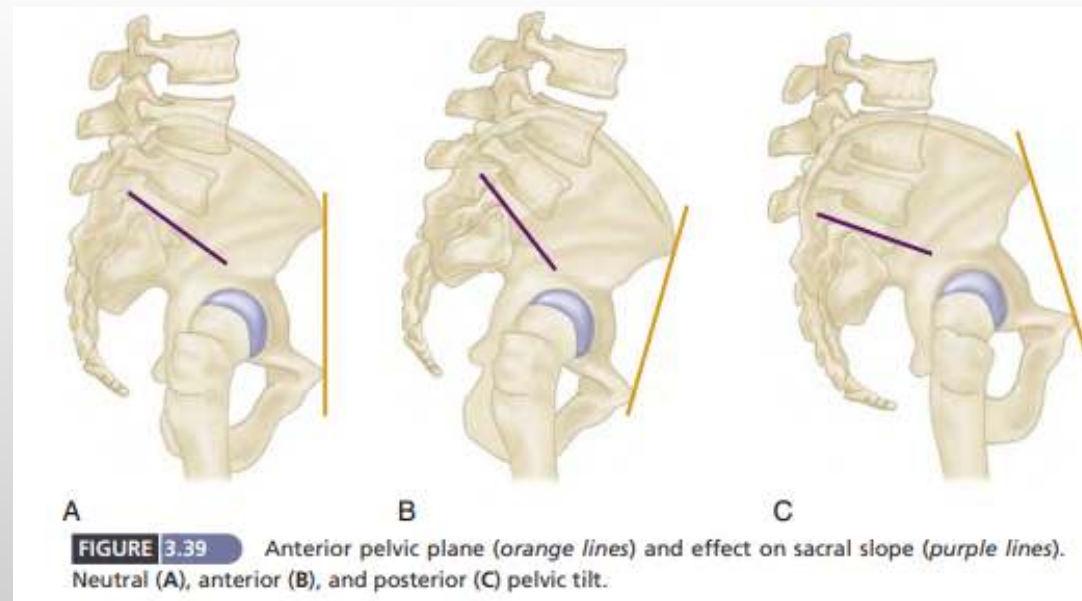
Hip-Spine

- *spinal fusion imparted a **two**fold risk of early hip dislocation and over **three**fold risk for revision.*
- *In normal patients, the lower lumbar spine is flexible in the sagittal plane*
- *. standing to sitting the pelvis tilts posteriorly to accommodate flexion of the hip.*
- ***1** degree of increased pelvic tilt, acetabular anteversion increases from **0.7** to **0.8**.*
- *This translates to a change of acetabular anteversion of approximately 15.6 degrees moving from standing to sitting position and reduces anterior impingement as hip flexes*

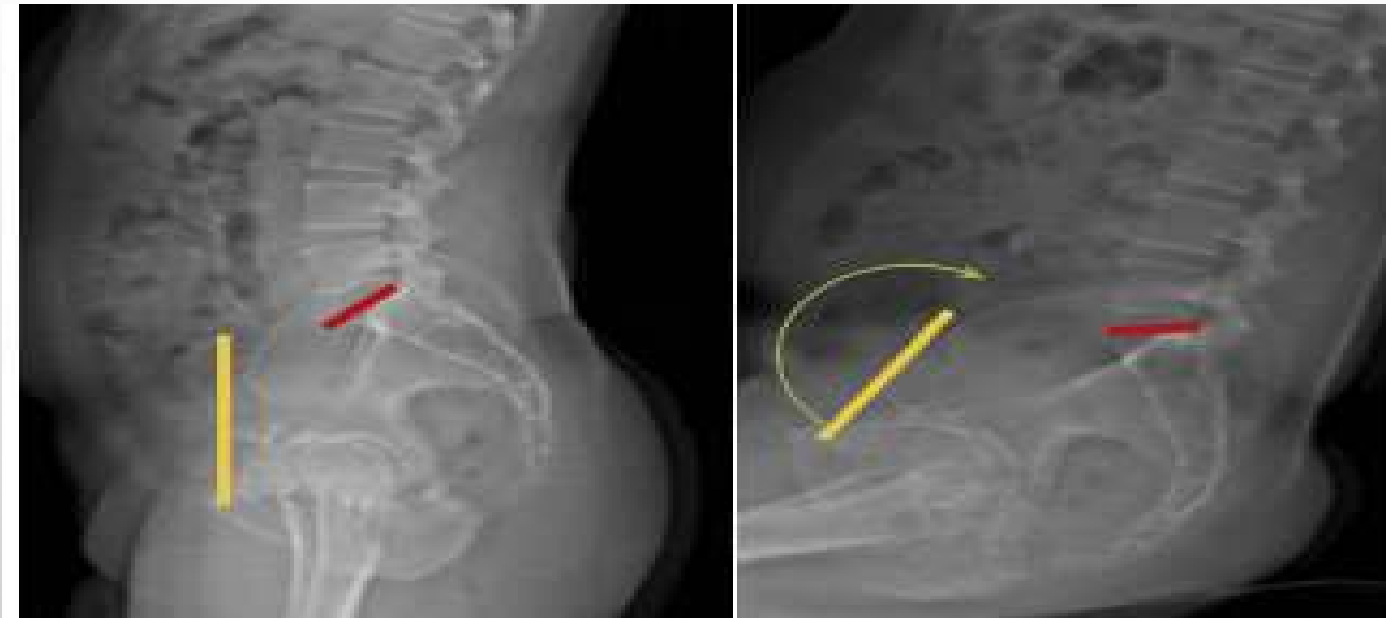
- *inclination increases with pelvic tilt protective of anterior impingement*



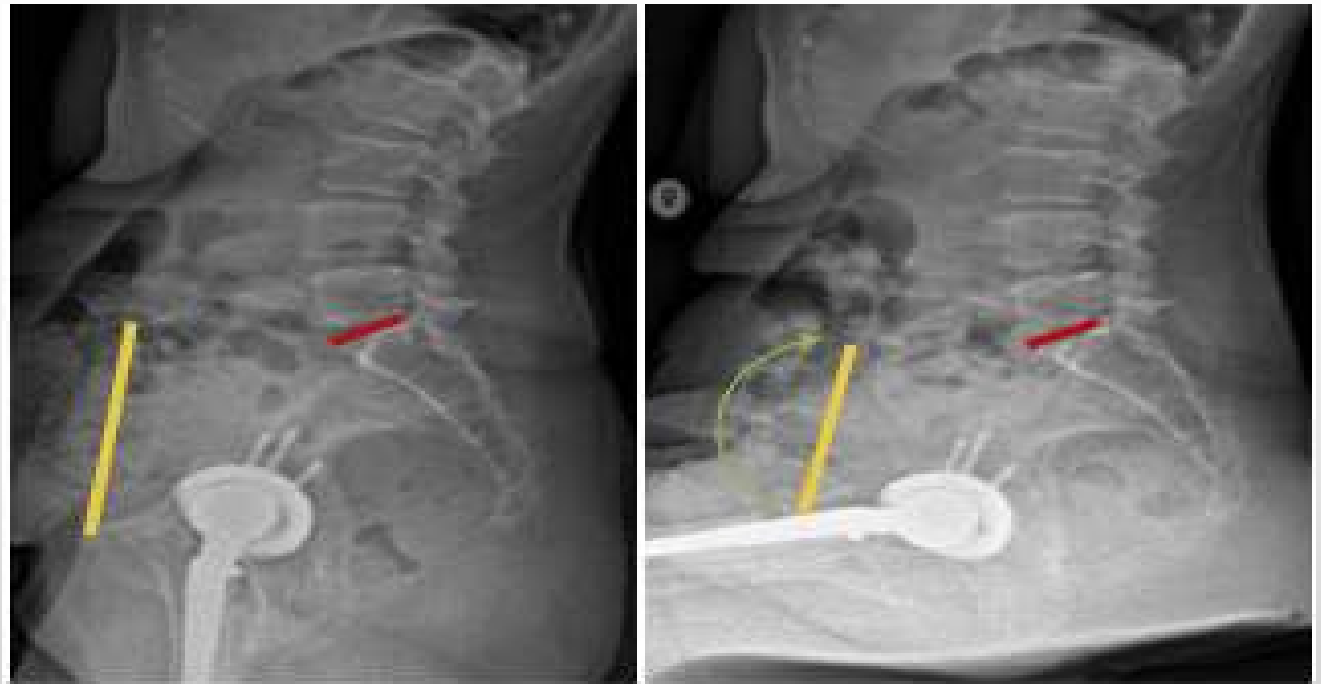
- **anterior pelvic plane** (APP) points of the two anterior superior iliac spines (ASIS) and the pubic symphysis on a lateral radiograph of the pelvis.
- Ant and post pelvic tilt describe the direction of motion of the upper portion of the ilium
- **Sacral slope** (SS) is the angle between the superior endplate of the S1 vertebra and a horizontal reference, typically the inferior border of the radiograph.
- Both APP and SS can be used to assess spinopelvic motion with **changes** in posture



- *Moving from a standing to sitting position*
 - posterior pelvic tilt*
 - reduction in lumbar lordosis*
 - flattening of SS*
- *normal change in SS from standing to sitting is between 11 and 30 degrees*



- *Spinopelvic stiffness change in SS of ≤ 10 degrees*
- *hip joint must **flex** further to assume a seated position,*
- *greater risk of anterior impingement*
- *more **anteversion** of the acetabular component will be needed to compensate*



pelvic incidence (PI)

anterior to posterior relationship of the femoral head to the lower lumbar spine.

*PI is a **fixed** value and does not change with posture*

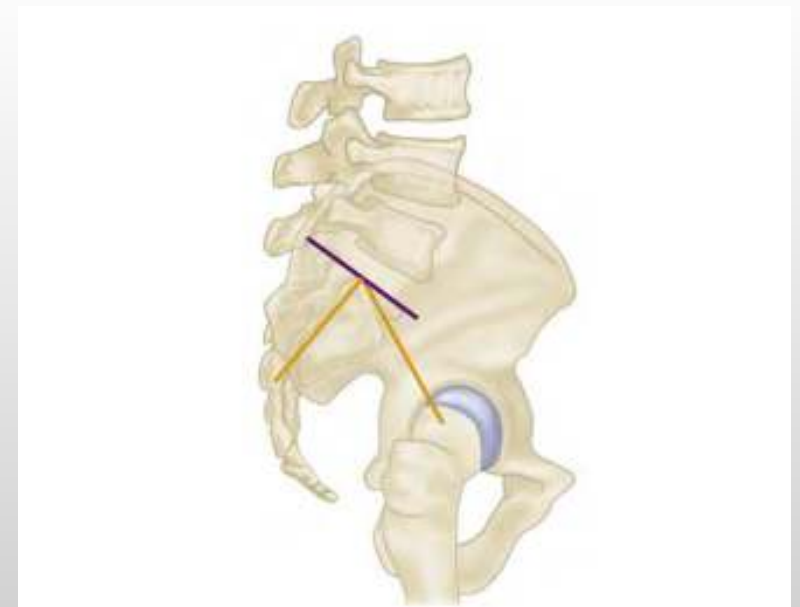
*it may identify patients with a **flatback** spinal deformity*

combined lumbar lordosis (angle between superior endplates of L1 and S1)

excessive posterior pelvic tilt while standing

risk of anterior instability.

acetabular component anteversion need to be reduced



The cost-effectiveness of dual mobility in a spinal deformity population with high risk of dislocation a computer-based model

A. M. Elbuluk, J. Slover, A. A. Anoushiravani, R. Schwarzkopf, N. Eftekhary, J. M. Vigdorchik

Published Online: 8 Oct 2018 Doi: <https://doi.org/10.1302/0301-620X.100B10.BJJ-2017-1113.R3>

- *under specific clinical and economic thresholds, DM components are a cost-effective form of treatment for patients with spinal deformity who are at high risk of dislocation after THA.*

Article

Trends in the use of dual mobility bearings in hip arthroplasty : an analysis of the American Joint Replacement Registry

Nathanael Heckmann, Dena S. Weitzman, Heena Jaffri, Daniel J. Berry, Bryan D. Springer, J. R. Lieberman

The Bone & Joint Journal | Volume 102-B, Issue 7_Supple_B | 30 Jun 2020

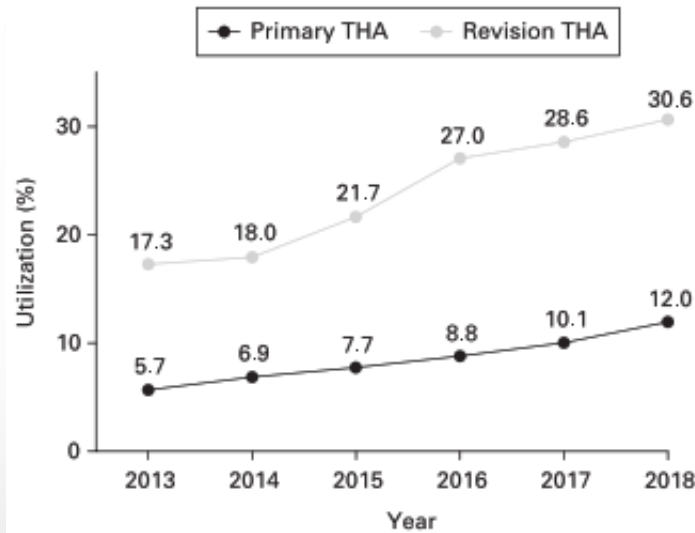
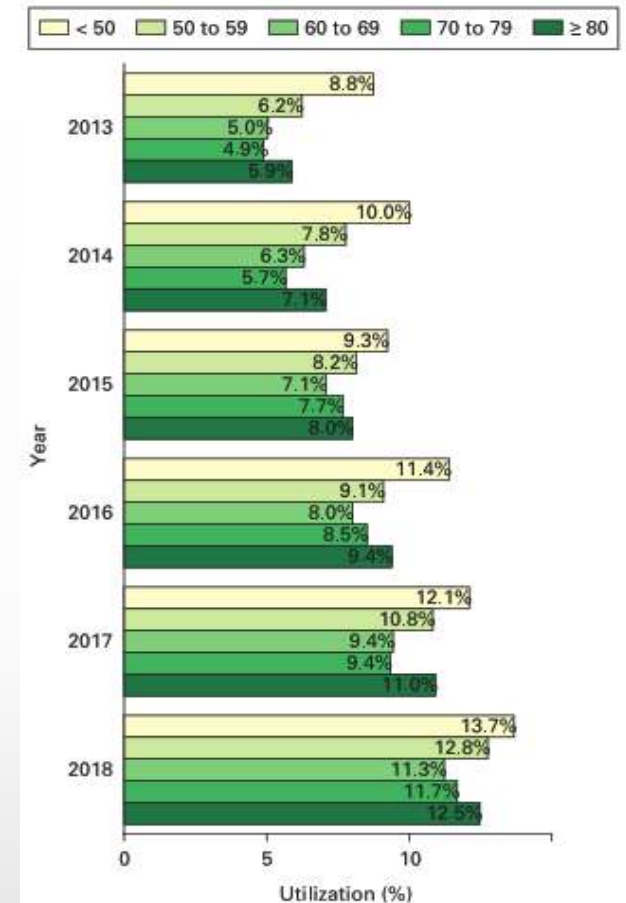


Fig. 2

Table IV. Odds ratios for dual mobility utilization by operating diagnosis for primary and revision total hip arthroplasty surgery.

Diagnosis	Odds ratio	Confidence interval	p-value
Primary THA (Reference: osteoarthritis)			
Osteonecrosis	1.212	1.143 to 1.285	< 0.001
Dysplasia	2.448	2.032 to 2.949	< 0.001
Femoral neck fracture	1.834	1.741 to 1.932	< 0.001
Rheumatoid arthritis	1.225	0.961 to 1.561	0.116
Post-traumatic arthritis	1.886	1.743 to 2.040	< 0.001
Revision THA (Reference: wear/osteolysis)			
Infection	2.002	1.741 to 2.302	< 0.001
Periprosthetic fracture	2.669	2.287 to 3.115	< 0.001
Aseptic loosening	2.204	1.928 to 2.520	< 0.001
Instability	3.130	2.751 to 3.562	< 0.001



Dual mobility utilization has increased markedly in the USA.

- *Younger* patient age and *female* sex were associated with increased utilization.

Dual mobility implants were used most commonly in primary THA for *dysplasia* and in revision THA performed for *instability*

MID-TERM OUTCOMES OF MODULAR DUAL MOBILITY IN YOUNG, ACTIVE TOTAL HIP ARTHROPLASTY PATIENTS

Ryan M. Nunley, Robert L. Barrack, Charles M. Lawrie

Published Online: 26 Oct 2020

 Sections

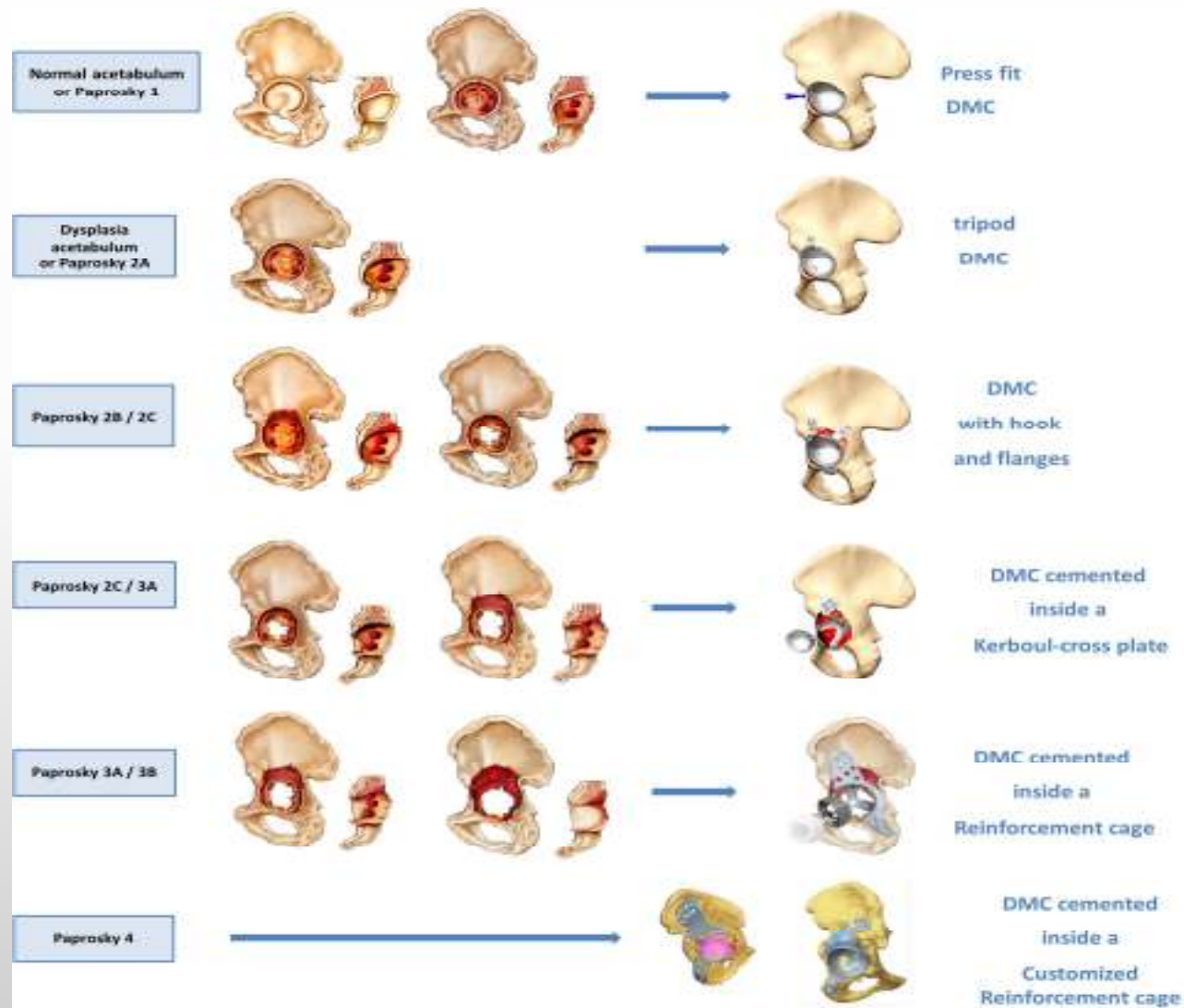
 Tools

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*A total of 43 patients (30 male, 13 female; mean age 52.6 years (sd 6.5)) were enrolled
At a minimum 5 years follow up, MDM with a modern cementless stem demonstrated minimal
stress shielding and no concerning metal ion release in young active patients.*




DM in the setting of revision surgery



Symposium: 2015 International Hip Society Proceedings | Published: 29 April 2016

Dual-mobility or Constrained Liners Are More Effective Than Preoperative Bariatric Surgery in Prevention of THA Dislocation

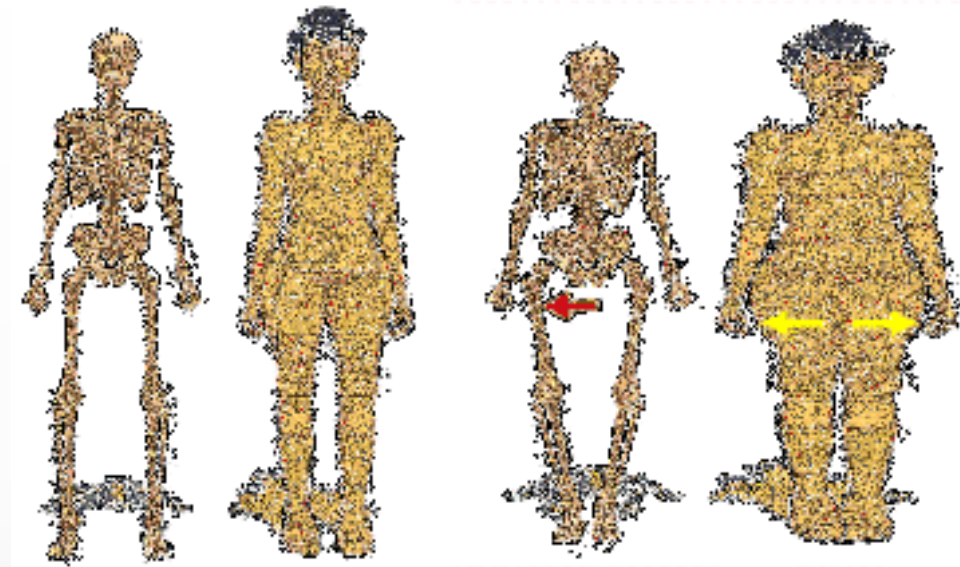
Philippe Hernigou MD , Matthieu Trousselier MD, François Roubineau MD, Charlie Bouthors MD & Charles Henri Flouzat Lachaniette MD

Clinical Orthopaedics and Related Research® 474, 2202–2210 (2016) | [Cite this article](#)

1764 Accesses | 22 Citations | 9 Altmetric | [Metrics](#)



A [CORR Insights](#) to this article was published on 25 May 2016



standard liners, the risk of dislocation is increased in patients with obesity.

Preoperative decrease of BMI (with bariatric surgery) in patients with obesity did not prevent the risk of dislocation with standard liners

. Use of dual-mobility or constrained liners in these patients is an effective technique to reduce the risk of postoperative hip dislocation

conversion



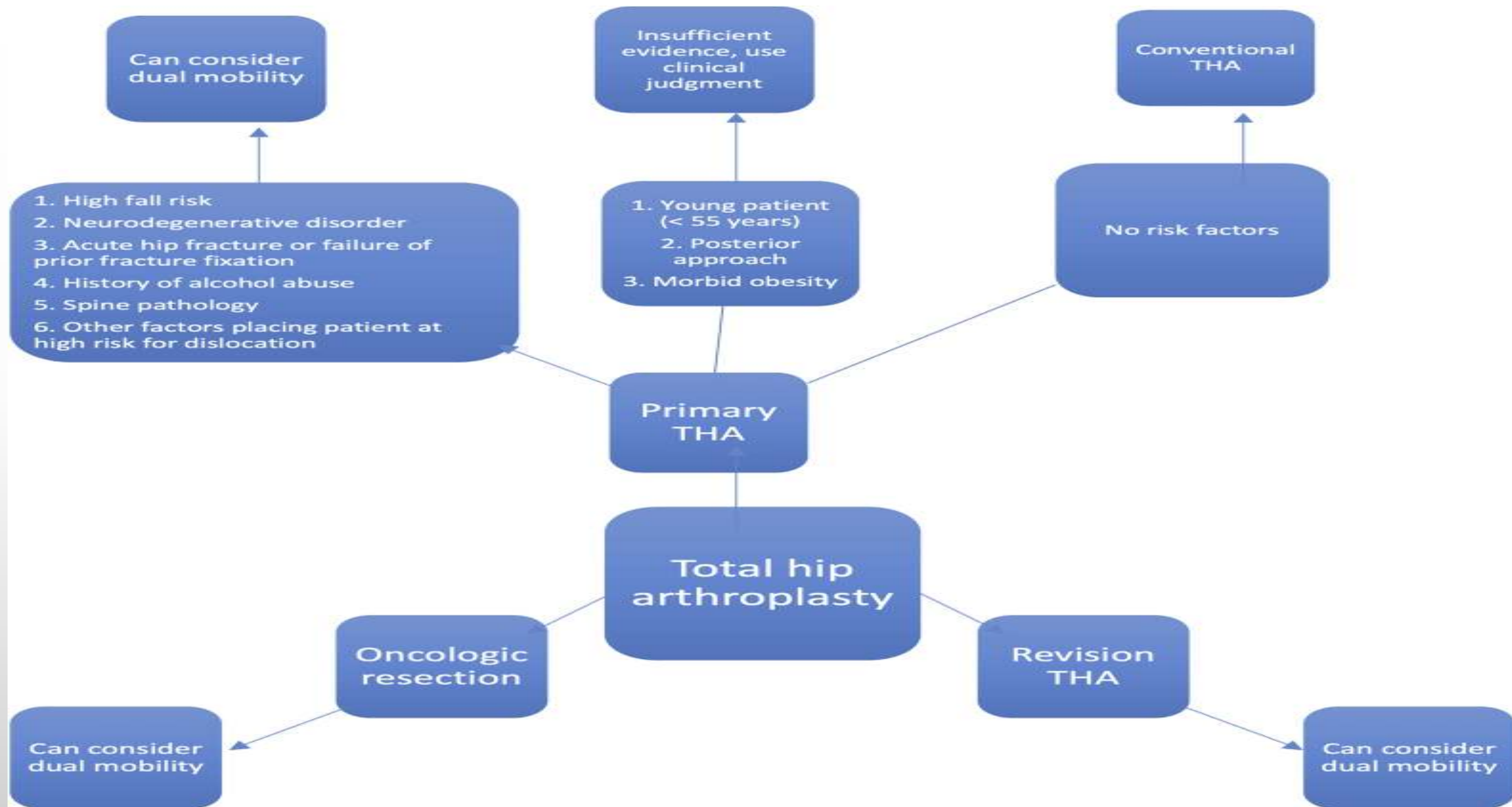
Why have Dual Mobility?

- Improve prosthetic stability, significantly reduce the risk of dislocation
- Increase amplitude of movement before impingement
- To reduce wear, « Low Friction Arthroplasty »
- To reduce shear forces at the bone interface which contribute to implant loosening

Indications:

Primary hip replacements, (at risk of dislocation)

- Elderly patients (> 65 or 70)
- Non compliant patients (dementia, alcohol..)
- Tumours
- Joint laxity (neuro muscular disorders, age)
- DDH
- RA
- Revisions, The risk of dislocation after revisions increases





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2020 AAHKS Annual Meeting Symposium

Clinical Concerns With Dual Mobility- Should I Avoid it When Possible?



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- *Bloemheuvel et al. no differences in revision rates at 5 years between DM THA compared with conventional THA*
- *Bearing complications using modern designs are rare but not nonexistent*
- *Current data support the selective use of DM articulations in patients at high risk for postoperative dislocation undergoing primary and revision THA.*

TAKE HOME MESSAGE

- *Dual mobility constructs are useful to reduce dislocation rates in complex primary.conversion and revision THA*

