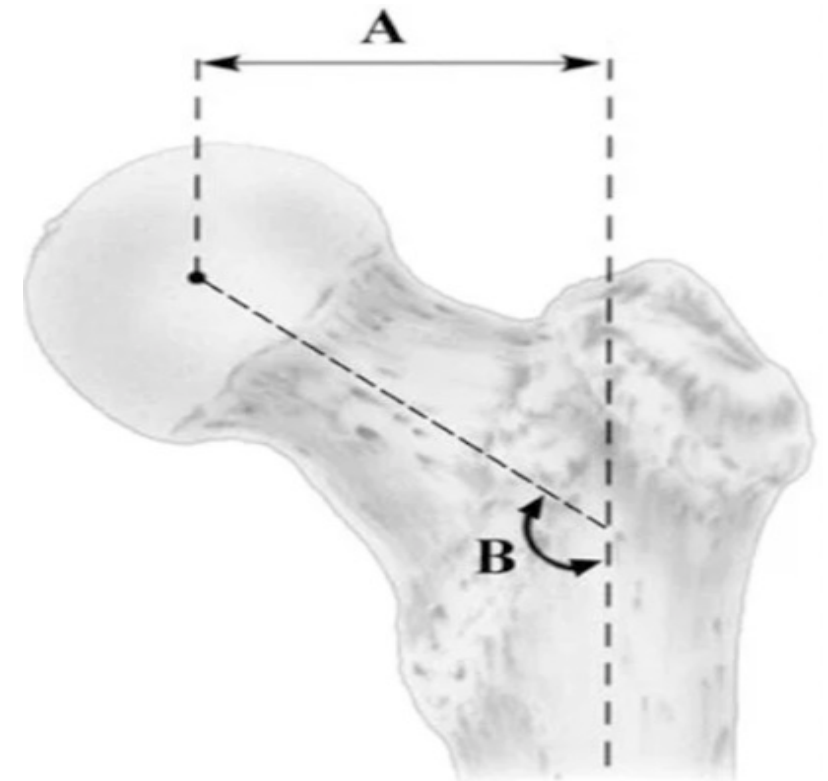


Femoral offset: general remarks and definitions

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DEFINITION

- Femoral offset is the perpendicular distance from the center of rotation of the femoral head to a line bisecting the long axis of the femur.
- Range, 41 to 44 mm.
- Radiological measurement.
- Varies according to the hip rotation.



Femoral offset is underestimated on anteroposterior radiographs of the pelvis but accurately assessed on anteroposterior radiographs of the hip.

RADIOLOGICAL ASSESMENT

- External rotation underestimates the true lateralization value (femoral offset).
- Accurate preoperative radiographs should be taken with the lower limb in internal rotation thus placing the patella in the frontal plane.
- The femoral neck is thus perfectly visible which allows accurate measurement of lateralization to the nearest mm during arthroplasty preoperative templating.

FUNCTIONAL IMPACT OF FEMORAL OFFSET



The femoral offset determines the abductor lever arm.

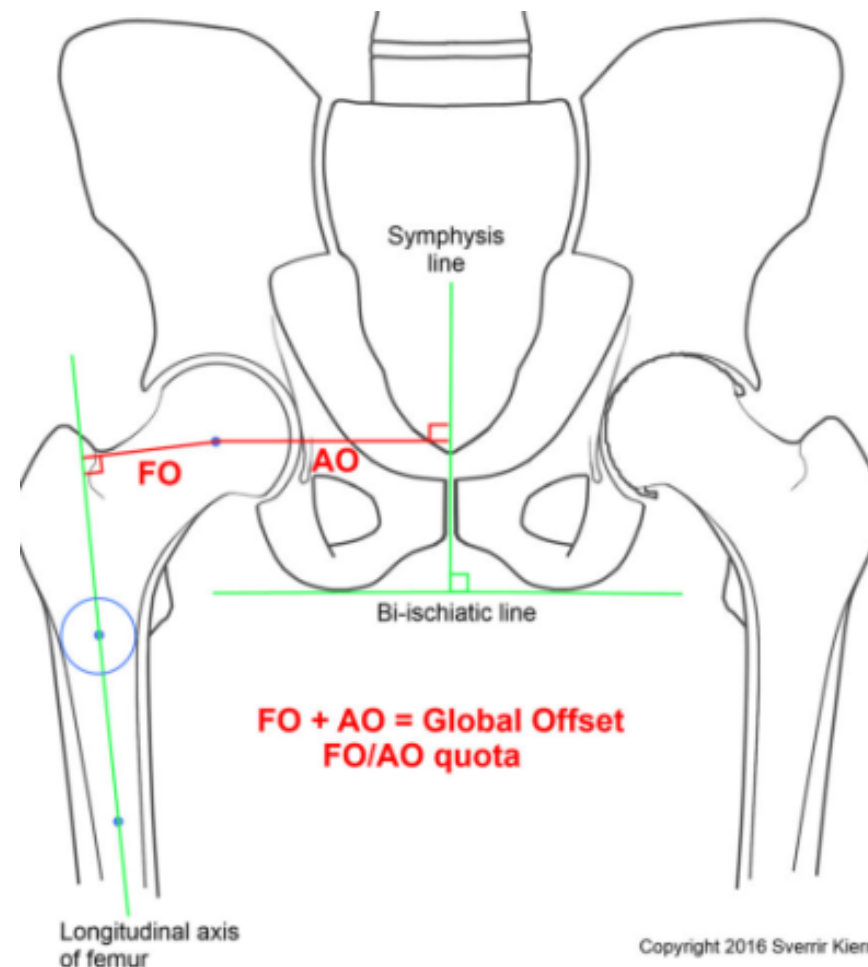
- Optimising femoral offset during hip surgery restores the soft tissue tension, minimises impingement, dislocation and implant loosening, but also improves the postoperative range of movement and normalises the gait pattern.
- A reduced femoral offset disadvantages the abductors by reducing the lever arm, increasing the joint reaction forces of the hip thus leading to increased wear of the bearing surfaces.

THE GLOBAL FEMORAL OFFSET

The global offset is the sum of the femoral offset and acetabular offset. It determines the tension of the abductor muscles.

Femoral offset (FO) is the distance between the longitudinal axis of the femur to the center of rotation. Acetabular offset (AO) is the distance between the center of rotation to the symphysis line. Global offset is the FO plus the AO

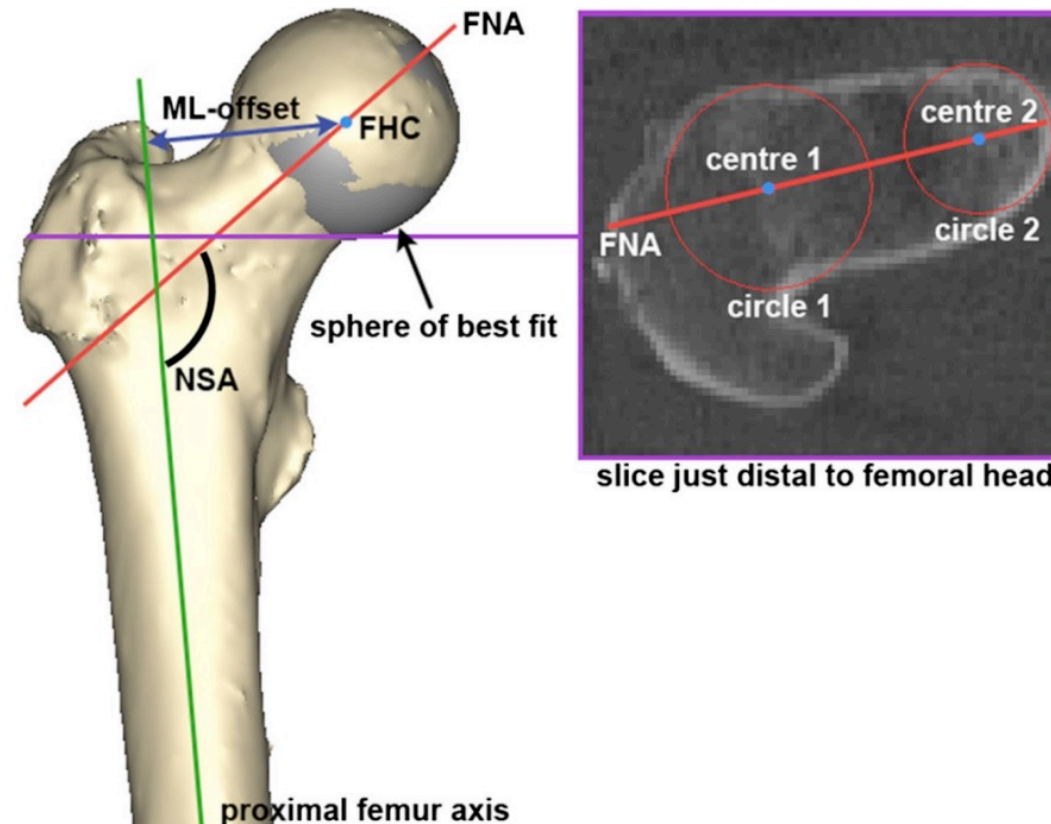
Kiernan et al. Journal of Orthopaedic Surgery and Research



ASSOCIATED NOTIONS

- The abductor muscle lever arm.
- The gluteus medius angle and force
- The cervico-cephalic angle
- Anteversion of the femoral neck

Fig. 2 Anatomical landmarks and morphological parameters of the proximal femur. *FHC* femoral head centre, *FNA* femoral neck axis, *ML-offset* mediolateral offset, *NSA* neck–shaft angle

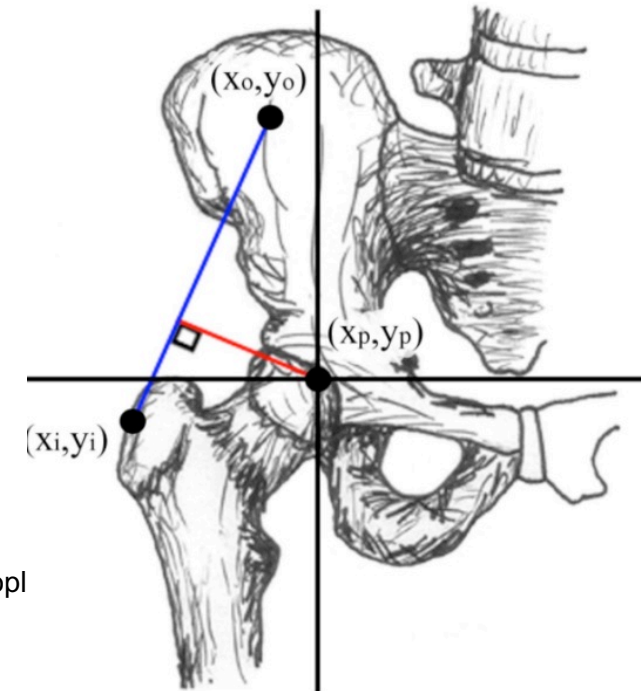


THE ABDUCTOR MUSCLE LEVER ARM

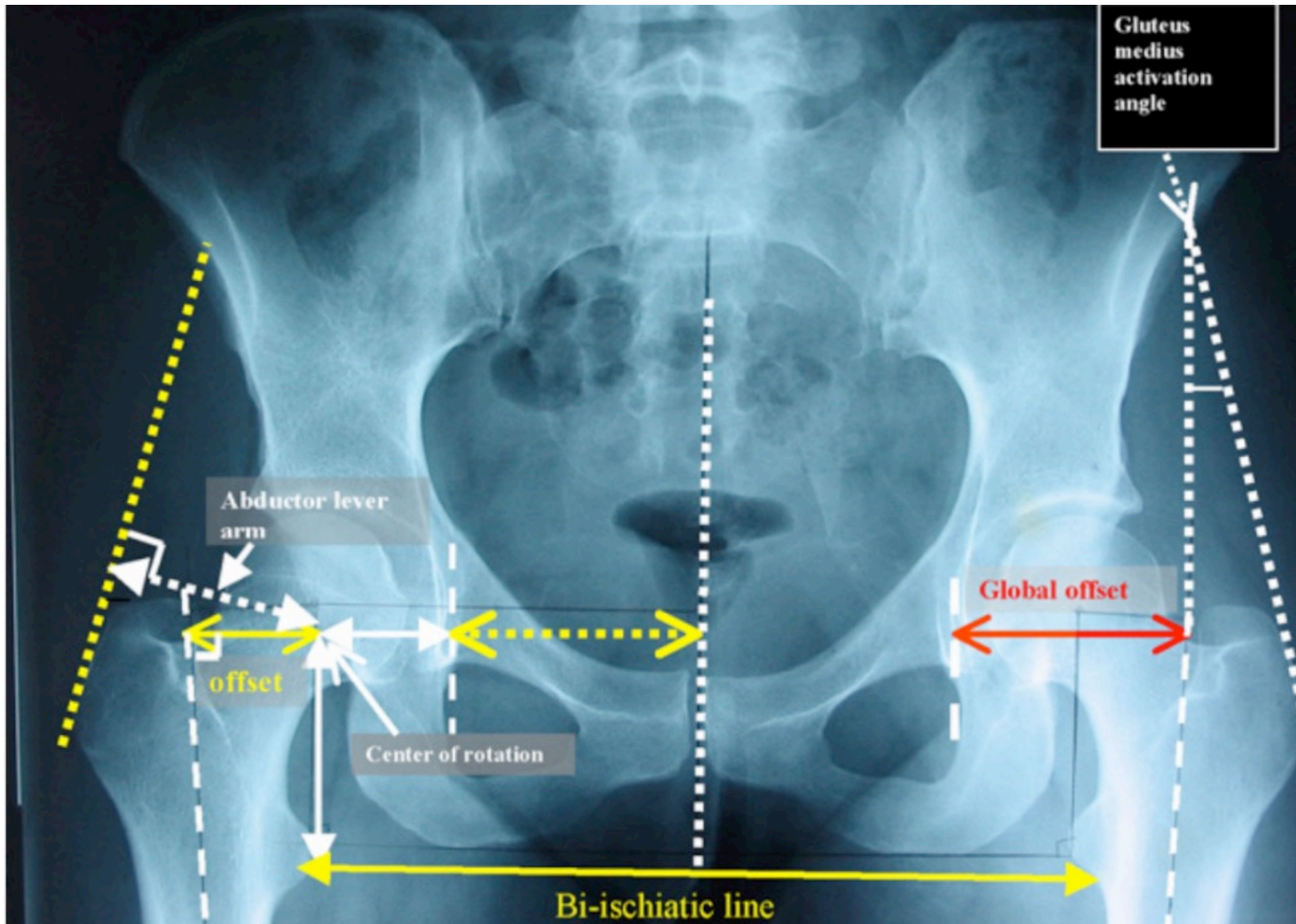
The path of the abductor muscles might be represented by drawing a line tangential to the lateral margin of the greater trochanter. The abductor muscle lever arm is thus perpendicular to it.

The work of Mac Grory demonstrates

- a significant statistical correlation between femoral offset and length of abductor muscle lever arm and strength.
- length of abductor muscle lever arm is among the most important factors influencing abductor muscle Strength.



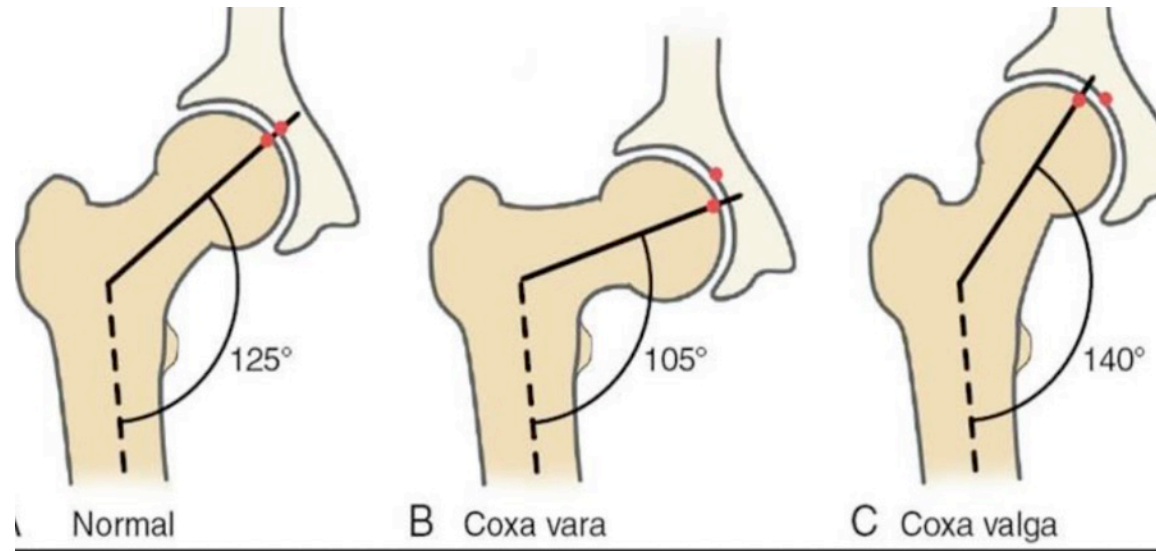
McGrory BJ, Morrey BF Effect of femoral offset on range of motion and abductor muscle strength after total hip arthropl



Correlation between The femoral neck-shaft angle and femoral offset

THE FEMORAL NECK-SHAFT ANGLE

The femoral neck-shaft angle (NSA) determines the size of the anatomical femoral offset.



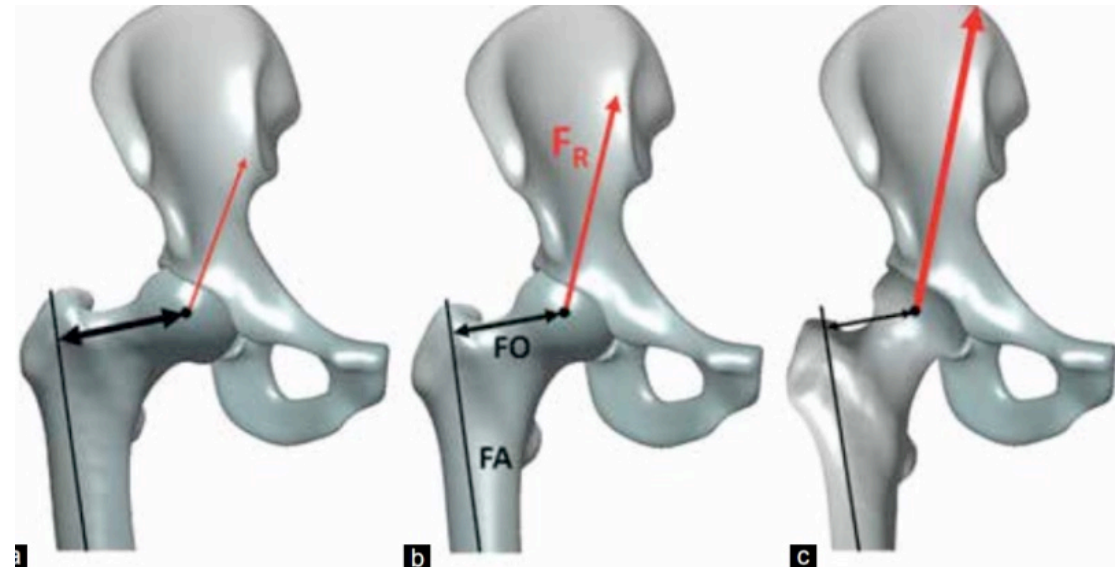
The femoral neck-shaft angle determines the size of the anatomical femoral offset and the force of abductor muscle.

- Lower NSA (Coxa vara) involves a higher femoral offset and a longer lever arm of the abductor muscles.
- Coxa valga: shorten the effective lever arm of the abductor muscles and reduced femoral offset.

Impact of neck-shaft angle on the femoral offset and hip joint reaction force.

An increased neck-shaft angle results in a decrease in femoral offset and increase in hip joint reaction force. (a) Varus hip configuration of 115° , (b) mean Caucasian hip configuration with neck-shaft angle of 130° , (c) valgus hip configuration of 142° .

FA: long axis of the femur, FO: femoral offset, FR: hip joint reaction force

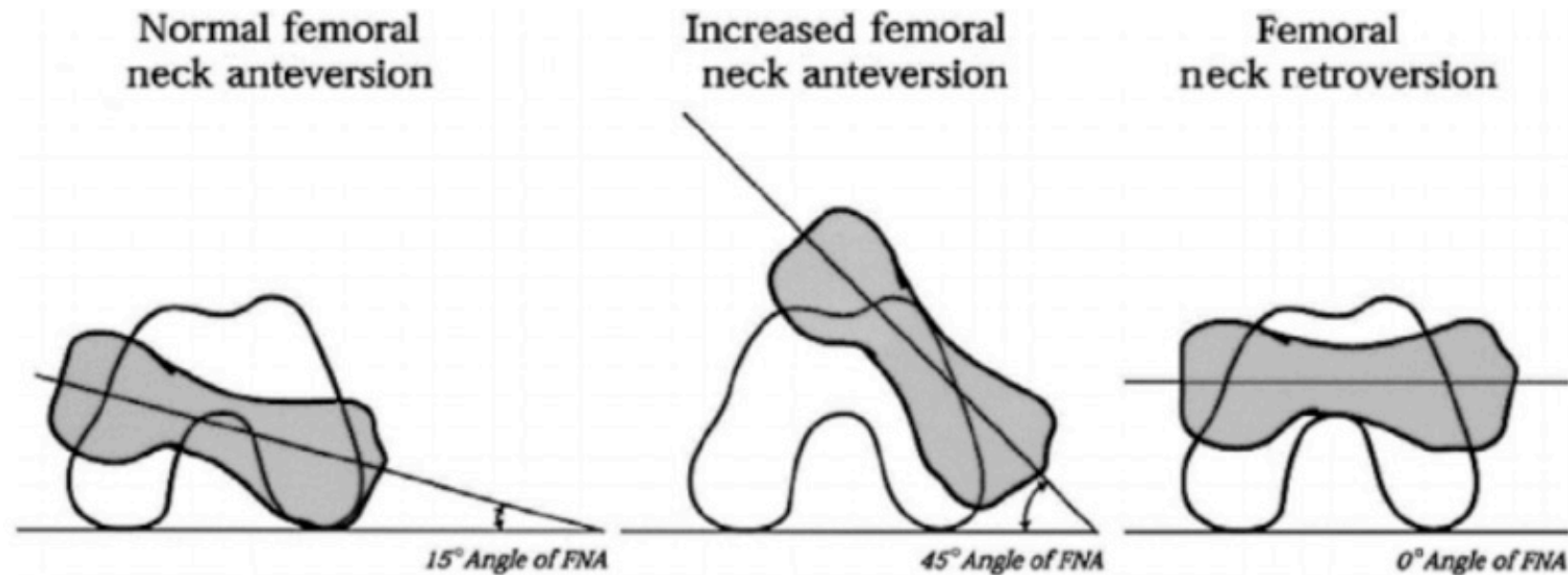


Correlation between the femoral anteversion angle and femoral offset

FEMORAL NECK ANTEVERSION

Femoral neck anteversion , also called femoral torsion or femoral version:

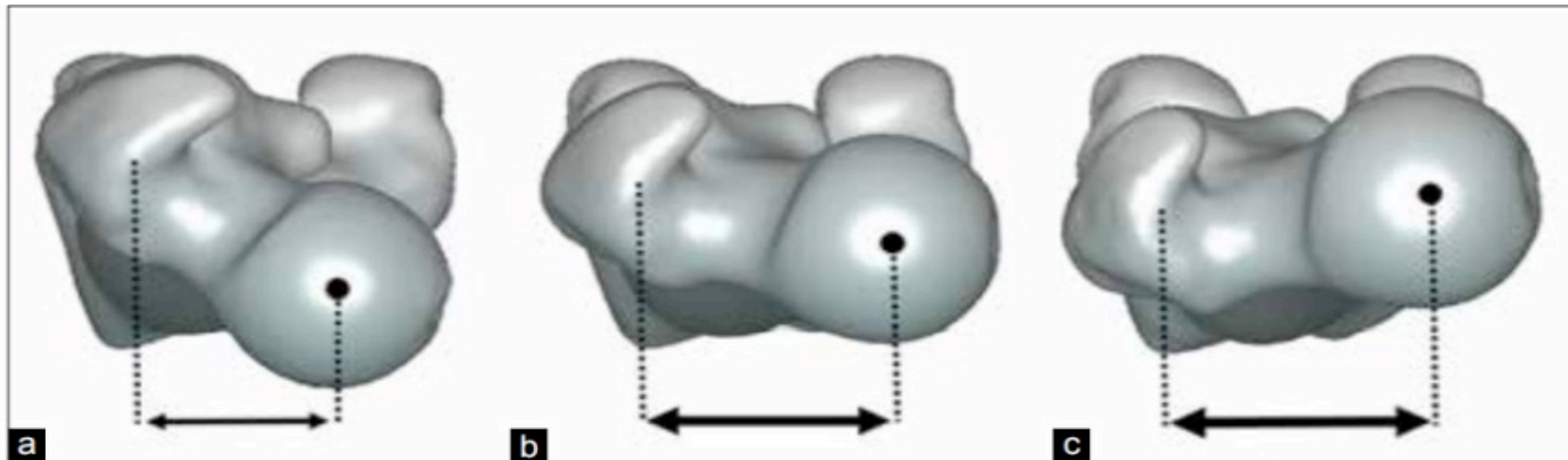
is the angle between the line going through the proximal femoral neck region and the second one through the distal condylar region, indicating the degree of ‘twist’ of the femur.



CORRELATION BETWEEN THE FEMORAL ANTEVERSION ANGLE AND FEMORAL OFFSET

Femoral neck anteversion defines the “physiological offset”:

Increase in femoral neck anteversion results in back displacement of the greater trochanter and decreases the functional offset, the lever arm and the gluteus medius strength.

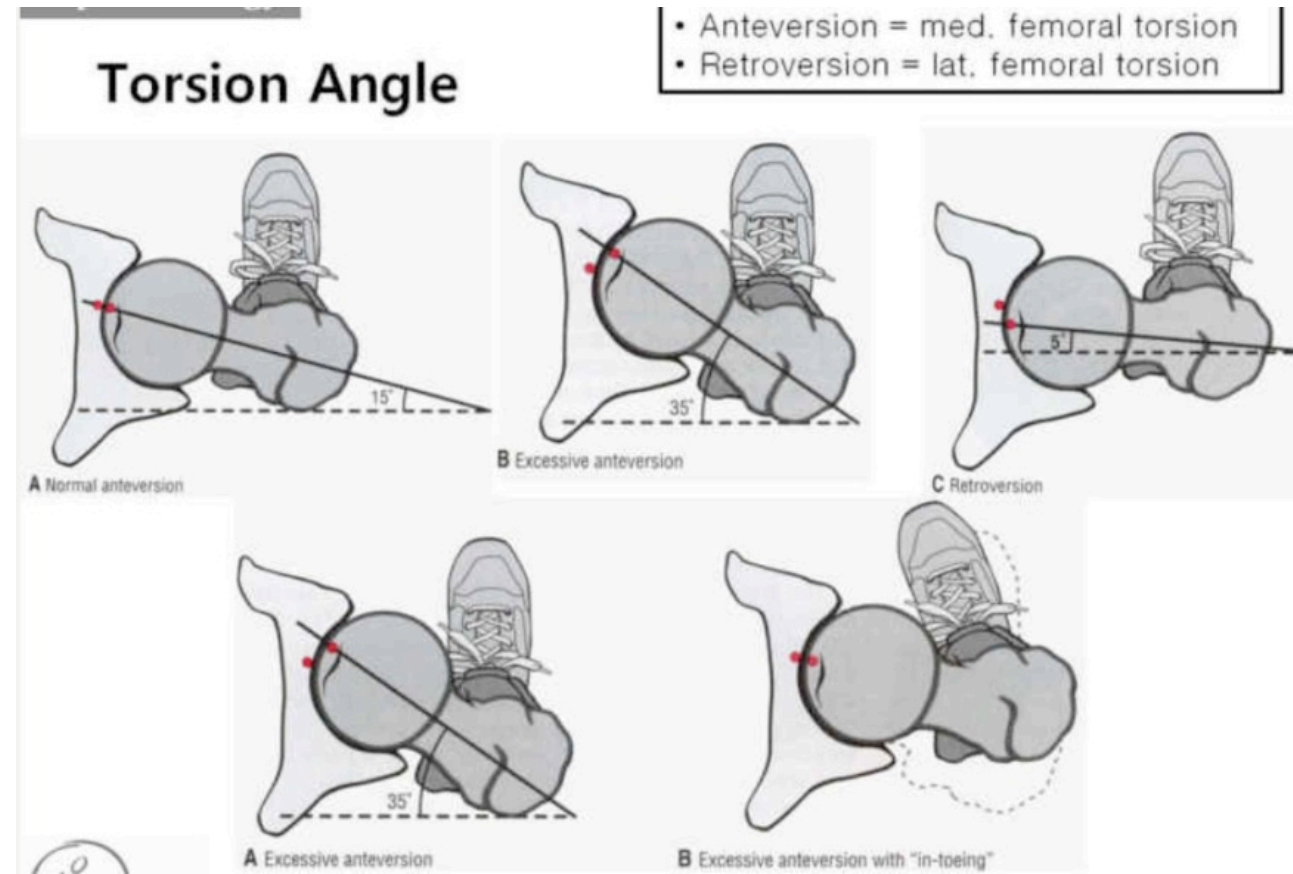


Impact of femoral version on the "functional" femoral offset. As the femoral anteversion increases, the femoral offset decreases resulting in higher hip joint reaction forces. (a) 35° of femoral anteversion, (b) 10° of physiological anteversion, (c) 10° of retroversion.

CORRELATION BETWEEN THE FEMORAL ANTEVERSION ANGLE AND GAIT

Femoral anteversion is characterized by:

- increased **anteversion of the femoral neck** relative to the femur.
- compensatory **internal rotation** of the femur
- lower extremity **intoeing**

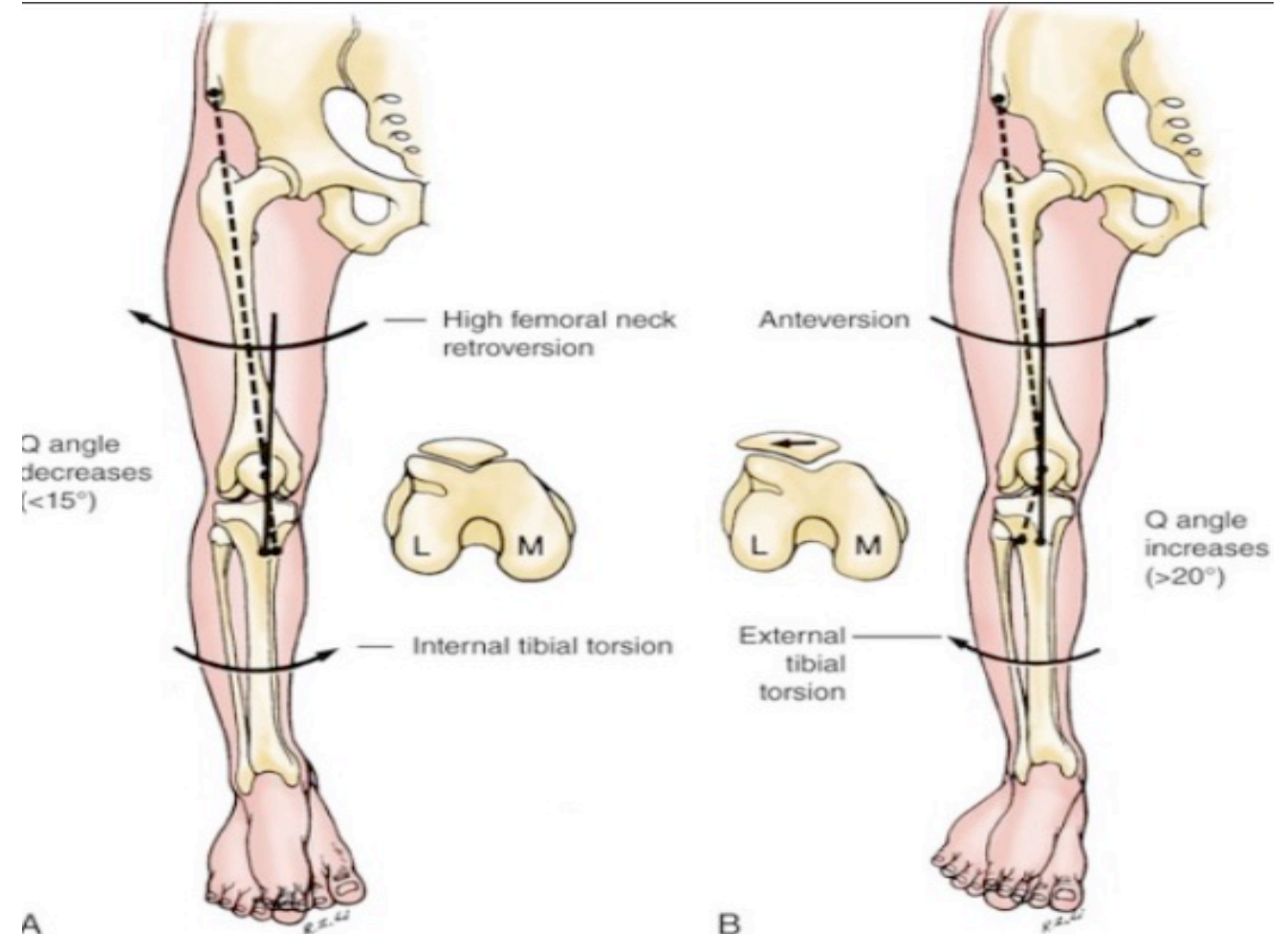


FEMORAL NECK ANTEVERSION AND PATELLOFEMORAL PAIN

Takai et al. studied the effect of rotational alignment of the lower limb in 43 patients with osteoarthritis of the knee and concluded that subjects with osteoarthritis of the patellofemoral compartment had a higher femoral neck anteversion angle.

Excessive internal rotation of the femur (high femoral neck anteversion angle) resulted in higher contact pressures on the lateral facet of the patella

Lee TQ, Anzel SH, Bennett KA, Pang D, Kim WC (1994) The influence of fixed rotational deformities of the femur on the patellofemoral contact pressures in human cadaver knees. Clin Orthop Relat Res.



FEMORAL NECK ANTEVERSION

Increase of femoral anteversion is associated with

- higher patellofemoral contact pressures,
- anterior knee pain and
- patellofemoral pain syndrome.

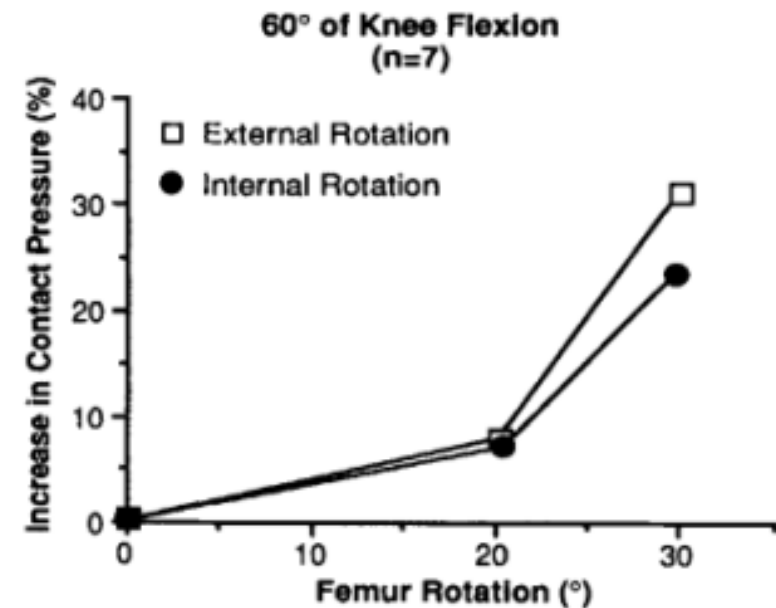
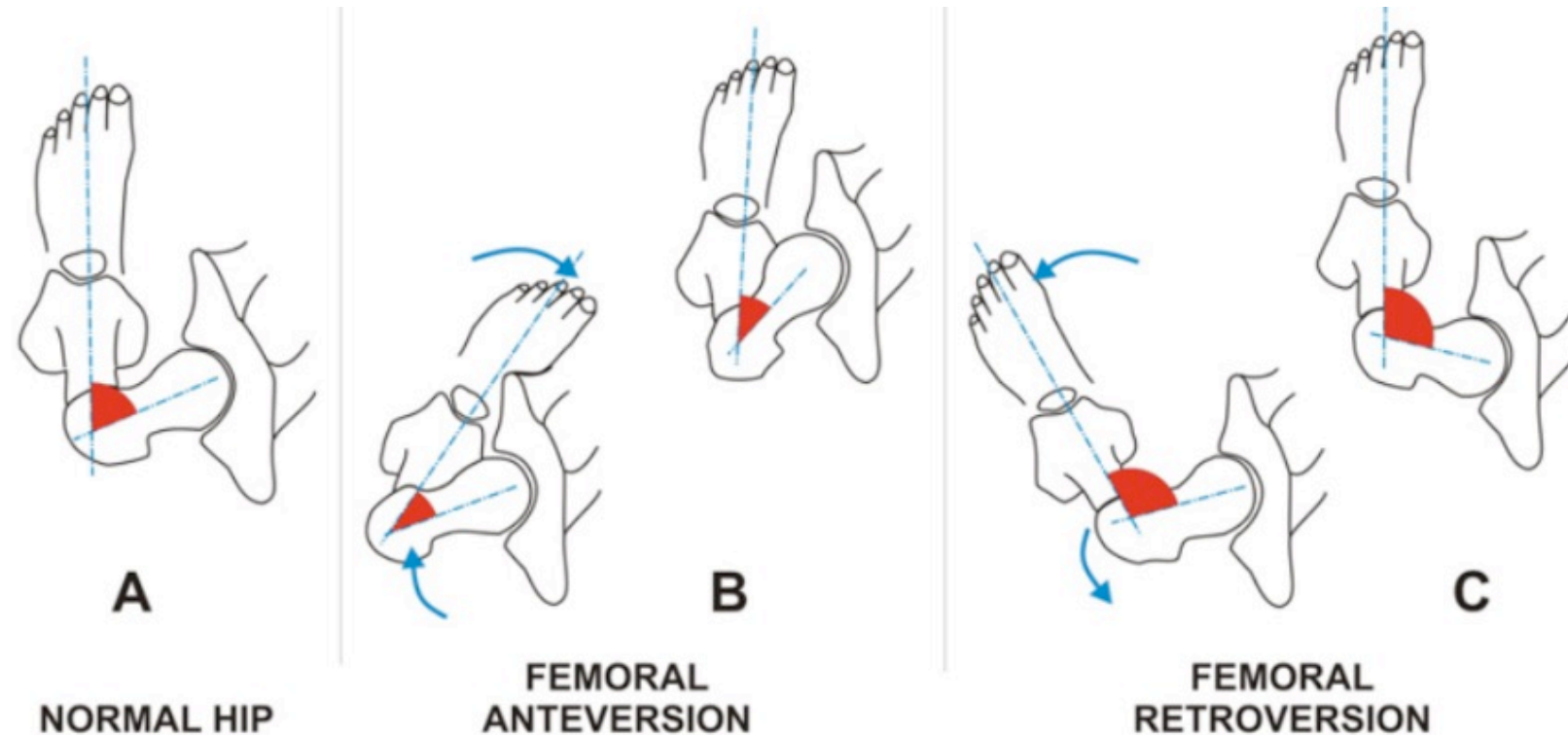


Fig. 3. The nonlinear increase in patellofemoral contact pressures with respect to the increase in the degree of rotational deformity of the femur at 60° knee flexion.

FEMORAL NECK ANTEVERSION

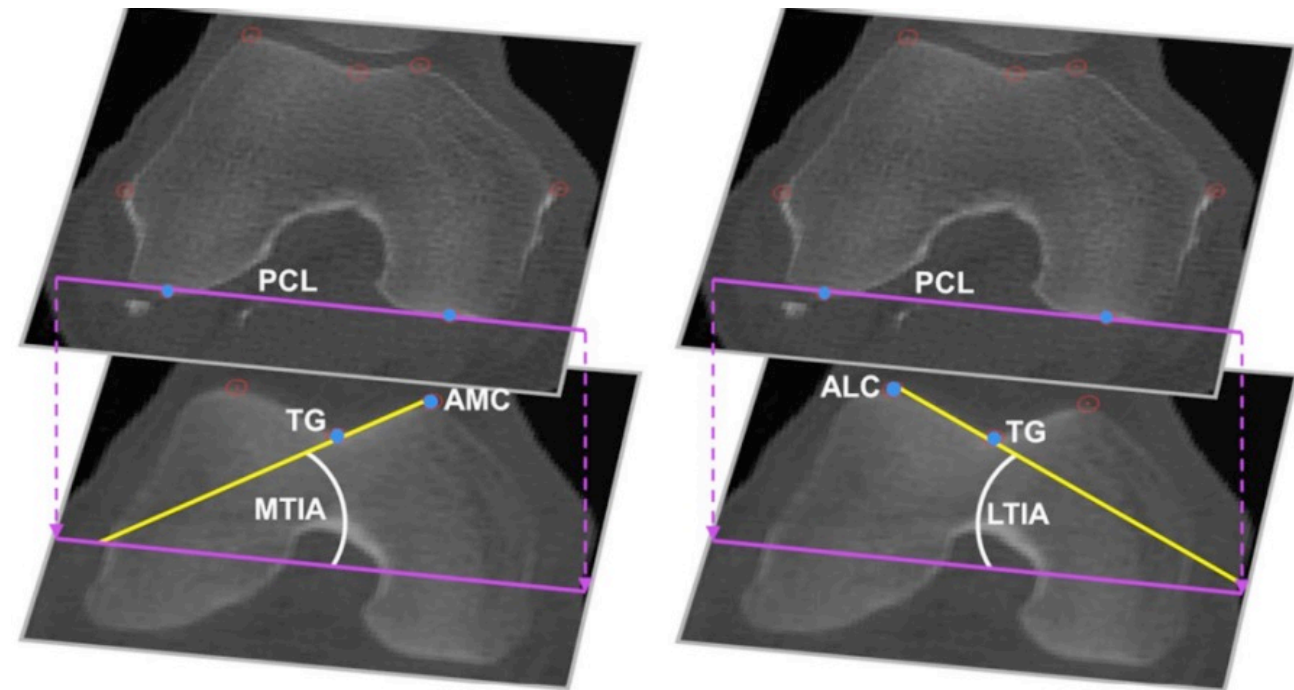
FNA affects the biomechanics of the hip, as moment arms and is associated with differences in gait.



Correlation between the morphology of the proximal femur and the geometry of the distal femoral trochlea

Strong correlation between the MTIA and the NSA and the fémoral offset.

Subjects with a larger NSA (coxa valga) and a smaller femoral offset had a smaller medial trochlear inclination angle MTIA on average.



- Samantha J. Wright · Tim. **Strong correlation between the morphology of the proximal femur and the geometry of the distal femoral trochlea.** Knee Surg Sports Traumatol Arthrosc (2014)

CORRELATION BETWEEN THE MORPHOLOGY OF THE PROXIMAL FEMUR AND THE GEOMETRY OF THE DISTAL FEMORAL TROCHLEA

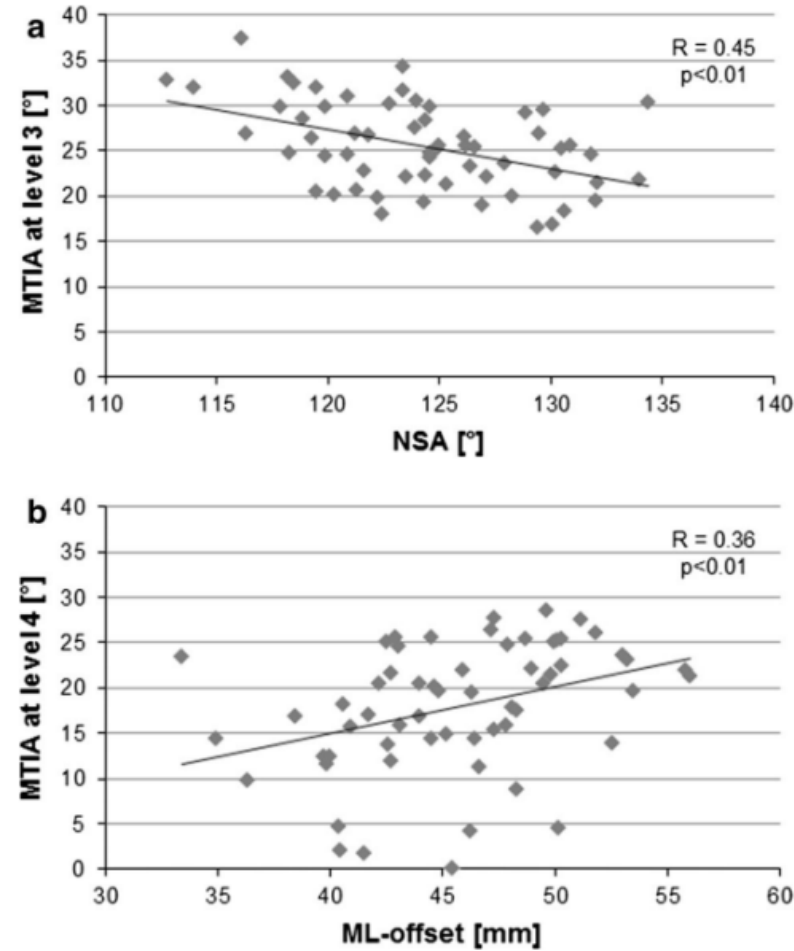


Fig. 8 Diagrams illustrating the correlation between the MTIA and NSA/ML-offset. **a** MTIA at level 3 (i.e. 10 mm proximal to the intercondylar notch) versus NSA. **b** MTIA at level 4 (i.e. 15 mm proximal to the intercondylar notch) versus ML-offset

CORRELATION BETWEEN THE MORPHOLOGY OF THE PROXIMAL FEMUR AND THE GEOMETRY OF THE DISTAL FEMORAL TROCHLEA

subjects with a **valgus hip** appeared to have a small mediolateral offset and a low femoral neck anteversion angle

=> This combination leads to an externally rotated leg and results in potential higher contact pressures on the medial trochlea, which in the long term

⇒ result in a flatter medial trochlear facet (i.e. low medial trochlear inclination angle).

Samantha J. Wright · Tim. **Strong correlation between the morphology of the proximal femur and the geometry of the distal femoral trochlea.** Knee Surg Sports Traumatol Arthrosc (2014)

correlation between The femoral neck-
shaft angle and knee osteoarthritis

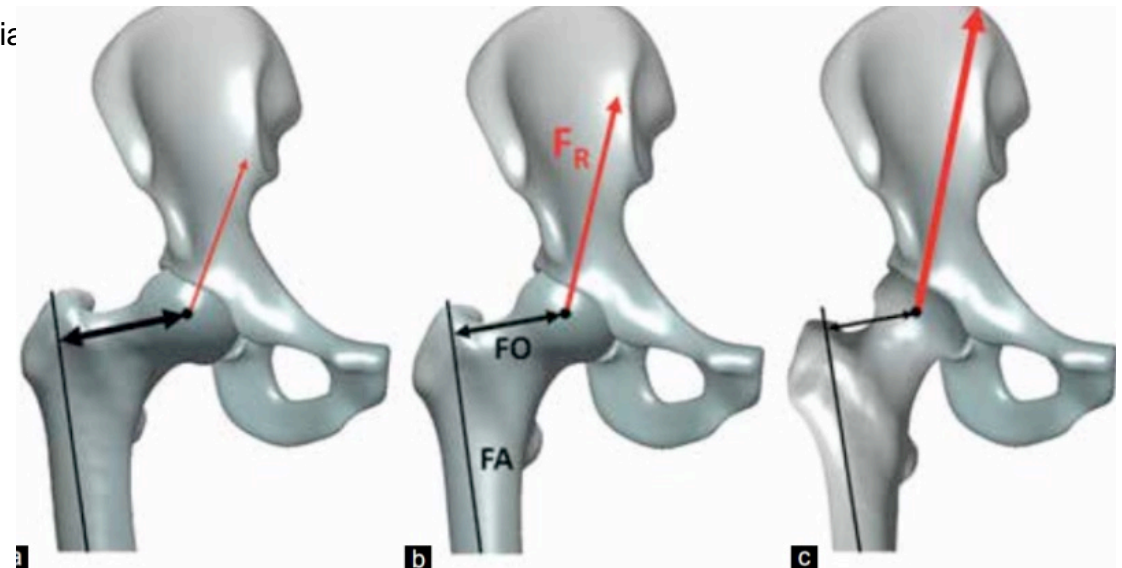
CORRELATION BETWEEN THE FEMORAL NECK-SHAFT ANGLE AND KNEE OSTEOARTHRITIS

Coxa vaga and reduced femoral offset, increased height of hip center, increased abductor angle correlate with a osteoarthritis of the lateral compartment of the knee.

Coxa vara with higher femoral offset leads to a more varus hip–knee–ankle axis with degenerative changes as a consequence on the long term (osteoarthritis of the medial compartment of the knee).

women were found to have a reduced FO compared to men

- Weidow et al. Medial and lateral osteoarthritis of the knee is related to vari
- Boissonneault et al, Osteoarthritis Cartilage. 2014.



Merci de votre attention