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The role of the extra-articular biomechanical parameters after total hip arthroplasty: an accurate restoration to the native anatomy leads to better results

The extra-articular parameters of the hip define joint's biomechanical morphology and behavior. A proper restoration of those biomechanical parameters is fundamental to achieve satisfactory outcomes in terms of hip functionality and patient's quality of life after total hip arthroplasty (THA).

The hip biomechanics parameters are the following:[1] center of rotation (COR) of the hip joint; acetabular height (AH), the distance from the COR to the inter-teardrop line (Figure 1);[1] femoral height (FH), the distance from the COR to the perpendicular line passing through the lesser trochanter and parallel to the anatomical axis (Figure 2);[1] acetabular offset (AO), the distance from the COR to the perpendicular line passing through the medial edge of the ipsilateral teardrop (Figure 3);[1] and femoral offset (FO), the distance from the COR of the femoral head to the anatomical axis (Figure 3).[1]

The amount of the AH and the FH determine the global height (GH) and therefore the lower limb discrepancy (LLD), while the amount of the AO and the FO is the global offset (GO). LLD and GO are strictly dependent on the surgical technique, the component positioning and, therefore, the restoration of the hip COR in the native position.[2]

When studying hip parameters restoration after THA, an AP pelvis X-ray should be available. LLD is measured between the femoral head and the lesser trochanter, but the real limb length should be assessed with a full leg length X-ray or, alternatively, by a clinical evaluation. In fact, the true length of the lower limb is conditioned by several conditions affecting spine, ipsilateral leg or contralateral limb. Conversely the study of the GO is more reliable as joint parameter. The only evaluation of FO is incomplete because GO takes into account also the acetabular cup placement.

It has been shown how a GO reduction of more than 5 mm is associated with less abductor muscle strength and decreased functional results after total hip arthroplasty.[3]

According to Bonnin *et al.*[4] GO should be restored to the native anatomy. Conventional acetabular preparation consists in deepening of the cup on the acetabular floor, leading to medialization of the COR and decreasing AO. Most of surgeons only restore FO, without regards to the AO. In these cases, is not necessary to implant a bigger cup in order to lateralize the COR, medialization of the cup gives biomechanical advantages according to Pawel's law and gives lower resulting forces at the head-cup interface. Thus, the FO should be increased in order to compensate the lack of AO.

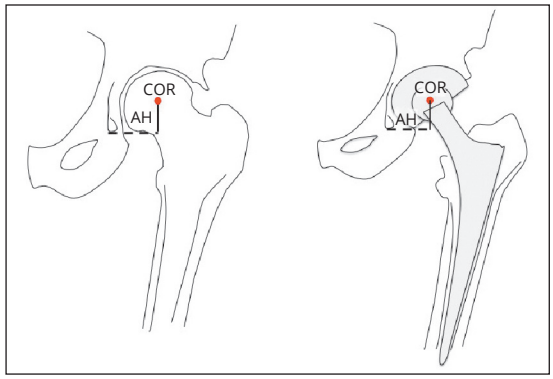

Figure 1.—The acetabular height according to Warnock *et al.*[1] AH: acetabular height; COR: center of rotation.

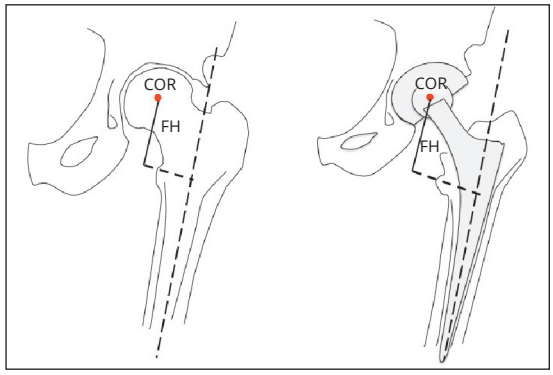

Figure 2.—The femoral height according to Warnock *et al.*[1] FH: femoral height; COR: center of rotation.

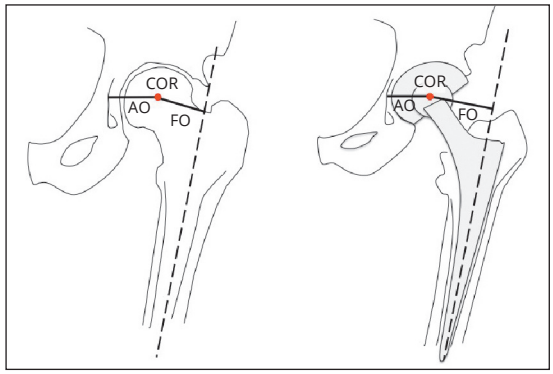

Figure 3.—The acetabular height according to Warnock *et al.*[1] AO: acetabular offset; FO: femoral offset; COR: center of rotation.

The above-mentioned parameters are also related both with hip biomechanics and lower limb gait. Restoration of lower limb length and GO within 5 mm increase ROM and gait kinematics; moreover, restoring GO correlate positively with the knee adduction moment (KAM). Indeed, increases hip offset, so the knee has a greater varus moment during walking. This means that exceeding GO can both increase gluteus tension and hip stability, but on the other hand could change load distribution on the knee joint, with more medial compartment wear.[5]

Restoration of hip parameters and geometry has important consequences both in hip biomechanics and in gait kinematics. Orthopedic surgeons should know the consequences of any alteration on joint's morphology; therefore, preoperative planning and a strict surgical technique are necessary.

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Masquelet technique in the treatment of big defect in severely contaminated open fractures: can bioactive glass S53P4 help in reducing the graft reinfection?

The masquelet technique is a two-step procedure to treat bone defects and nonunion with a high percentage of success and low complication rates. It has been reported to be effective in defects up to 25 cm.[1] It consists in a first step where all dead bone and tissues are removed leaving a void that is filled with cement. In septic cases a long-term antibiotic therapy is associated. After being sure that infection is cured the second surgical step is done. This consists in cement removal, preservation of the peripherally newly formed "induced membrane," bone stabilization and void filling with autologous bone graft.[2] Two major complication are reported: graft reinfection and donor site morbidity.

Accurate debridement, extensive resection of all contaminated tissues including the bone and long-term antibiotic therapy can help in reducing infection recurrence. To avoid donor site morbidity, the use of allograft has been suggested. Autologous bone can be used alone or, in case of big defects, mixed to allografts.[3] On the other hand, the use of dead bone has a higher risk of infection recurrence probably related to the lack of vascularization of the graft in a contaminated field. This is probably because bacteria can adhere to the dead bone and develop a biofilm. For this reason, a ratio not exceeding 1:3 is recommended when mixing allograft to autograft.[4]

A way to reduce infection rate is to add to the graft substances able to act against bacterial growth.

Bioactive glass has been shown to have antibacterial, osteoconductive and angiogenic properties,[5, 6] bioactive glass S53P4 promotes new bone formation by chemically binding to bone matrix.[7] At the same time antibacterial properties are related to an increase in the local