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SYMPOSIUM: ABJS CARL T. BRIGHTON WORKSHOP ON HIP PRESERVATION SURGERY

Report of Breakout Session

Defining Parameters for Correcting the Acetabulum During a Pelvic Reorientation Osteotomy

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Where Are We Now?

Treatment of typical developmental dysplasia of the hip (DDH) addresses instability and abnormal load transmission to the hyaline cartilage based on accepted biomechanical concepts. The treatment goal is to obtain a durably pain-free and functional hip. It remains unclear whether surgery can delay or prevent early osteoarthritis [5, 7, 10, 11] and if so in which patients.

We believe adolescent and young patients with pain in a dysplastic hip in the absence of advanced osteoarthritic signs and a good ROM are the best candidates for surgical correction of the deformity [2, 10, 11]. There is agreement that a pelvic osteotomy with reorientation of the acetabulum is the procedure of choice. Preoperative imaging should include an AP pelvis radiograph, a lateral view, and a false-profile view. In patients with joint incongruency on the AP pelvis view, we recommend an AP pelvis radiograph with bilateral hip abduction, internal rotation, and about 15° of flexion. This functional view can provide a sense of the joint geometry after a surgical reorientation of the acetabulum. Radiographic analysis includes evaluation for joint instability [2], which seems to be represented by the following: lateral and cranial migration of the femoral head best seen by a superomedial widening of the joint space and a marked difference between the center of the head and the acetabulum, a broken Shenton's line, and cranial narrowing and posterior widening of the joint space on a false-profile view.

Further radiographic analysis must implement established parameters for measuring a deficient acetabular coverage and abnormal version: the lateral center-edge angle (LCE); orientation of the roof (anterior center-edge [ACE] angle); lateralization of the head center in respect to the ilioischial line; version of the acetabulum defined by the outline of the anterior and posterior rim, as well as the presence or absence of a crossover sign; and alpha angle to identify an abnormal head-neck junction.

Frequently used reorientation procedures of the acetabulum are a triple osteotomy, a spherical or rotational osteotomy, and a Bernese periacetabular osteotomy. We agree intraoperative evaluation of the reoriented acetabulum should be mandatory. Commonly, an intraoperative AP pelvis radiograph is taken to judge correction. Plain pelvic radiographs during surgery in a supine position can be compared to pre- and postoperative radiographs. As a rule, the tube-to-film distance typically is 1.20 m, with the central beam located in the middle between the upper

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border of the symphysis and a line connecting the two anterior superior iliac spines [9]. Deviation of the tip of the coccyx from the middle of the symphysis indicates malorientation of the pelvis, and after repositioning of the patient, the radiograph should be repeated. With the use of additional tools or more sophisticated orientation of the x-ray beam, fluoroscopy also can be used for intraoperative evaluation of the corrected acetabulum [6, 14].

Spatial acetabular orientation can be identified by outlining the contours of the anterior and posterior rim. Recommendations for defining the correction parameters can only be given in ranges and not to the exact degree and should be adapted to the individual pathomorphology. There is general agreement about the useful parameters and recommended goals: an LCE angle of between 20° and 35°, preferably in the upper 20s; an ACE angle of between 0° and 10°, preferably in the upper range; head medialization with a distance of the medial femoral head to the ilioischial line of less than 10 mm; restoration of Shenton's line; a weightbearing dome centered over the head; anteversion of the acetabulum as defined by the absence of a crossover sign and the outlines of the anterior and posterior rim meeting at the lateral acetabular edge; and restoration of hip congruency [1, 4, 11, 13].

Two additional issues seem essential after reorientation and preliminary fixation of the dysplastic acetabulum. (1) In cases of joint incongruency, intraoperative functional views in abduction or adduction should be added to consider the need for further improvement of acetabular reorientation or an additional intertrochanteric osteotomy. (2) Improvement of anterior coverage bears the risk for anterior femoroacetabular impingement. Thus, the need for additional improvement of the head-neck offset in hips with a restricted internal rotation (IR) should be considered [8, 15]. However, this issue is controversial at this time. On the one hand, while most authors agree restricted IR should lead to an exclusion of impingement of the neck against the anterior rim or anterior inferior spine, there is no agreement as to the exact degree of IR needed; an IR of less than 15° to 30° could be considered crucial for initiating an arthrotomy. On the other hand, some authors do not consider improvement of the offset a necessary step during acetabular reorientation and question its influence on final outcome [14].

Where Do We Need To Go?

We are aware, in the majority of cases, not all parameters can be idealized due to the deficient nature of a dysplastic hip. In the future, predictive values and the adequate range of the recommended parameters must be analyzed and validated in regard to long-term survival of operated hips. This may include new and easily applicable parameters for quantification of anterior and posterior wall coverage or dome orientation. We should analyze to what degree correction of acetabular version and especially improvement of the head-neck offset will influence long-term function and durability of the hip. The key question will be how well we can delay progression to disabling osteoarthritis in these patients.

We also believe ideal correction in the future should be tailored to the individual hip. Pathomorphologic features of the proximal femur in DDH seem underestimated [11] and published studies largely ignore potential important factors such as torsional deformities of the femur. Objective measurements of achieved head coverage and the morphology of the femur are mandatory.

How Do We Get There?

More long-term (20 years or more) studies will be needed to answer questions concerning the degree and duration of functional improvement. Ultimately, these studies will provide an answer concerning the efficiency of delaying or preventing osteoarthritis when compared to published studies about the natural course of osteoarthritis in DDH [5, 7]. Multicenter studies might speed up this process since a larger number of patients could be gathered in a shorter period of time. Postoperative analysis should include routine measurement of acetabular and femoral torsion, as well as head sphericity and head-neck offset [8] and their influence on outcome. An identified list of predictive factors will likely improve patient selection and help to find a consensus for the key parameters to achieve more favorable results. This would also give hints as to whether selected individual hips might benefit from a different degree of acetabular orientation.

We also believe there is a place for more elaborate three-dimensionally based planning and navigation tools in the future. This also would include the amount and effect of torsional deformities of the femur and acetabulum. Computer-animated motion of individual hips may help to identify a potential postoperative impingement conflict and/or allow for more sophisticated preoperative planning [12]. An efficient and simple navigation tool during acetabular reorientation likely would facilitate the procedure and make reorientation more reproducible.

Ultimately, modern imaging techniques such as delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) scans of the hip may predict early failure in preoperative analysis of the cartilage condition. Low dGEMRIC indexes correlate with failure of the osteotomy and might be an important tool in the future for noninvasive analysis of the hip condition [3].

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