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CORR Insights

CORR Insights®: Operative Fluoroscopic Correction Is Reliable and Correlates With Postoperative Radiographic Correction in Periacetabular Osteotomy

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Where Are We Now?

Acetabular dysplasia commonly causes secondary arthritis of the hip [2]. Today, the so-called Bernese periacetabular osteotomy (PAO) is one of the most frequently and successfully used joint preserving surgical procedures designed to manage dysplasia in the young active patient [12]. This complex procedure combines a polygonal juxta-articular osteotomy using a modified Smith-Peterson approach. Proper acetabular reorientation can improve long-term survivorship and decelerate the progression of degenerative changes [1]. Overcorrection can produce femoroacetabular impingement, undercorrection may leave a patient with persistent symptoms, and poor congruency of the joint can cause abnormal contact stresses and accelerated chondral damage [4, 9]. Thorough preoperative planning is fundamental in PAO, and is based on plain radiographs and, more importantly, on CT imaging [6]. Clearly, accurate intraoperative imaging is required for implementation of the surgical plan. Fluoroscopy is commonly used for guidance while carrying out this complex osteotomy and for assessment of acetabular fragment reorientation, femoral head coverage, and osteotomy fixation. High-volume surgeons with extensive PAO experience do not necessarily need intraoperative fluoroscopy to check their osteotomy positioning, and prefer plain radiographs for assessment of acetabular reorientation. Intraoperative plain full pelvis radiographs are still considered the best available test under reasonable conditions [2]. However, serial intraoperative radiographs are time-consuming, and therefore, often are replaced by fluoroscopy.

The current study by Wylie and colleagues is a valuable contribution in the quest to test the correlation

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between plain radiographs and the reliability of fluoroscopy for assessment of femoral head lateral coverage during PAO. This large sample-size study with reproducible methodology is particularly relevant for surgeons with a special interest in joint-preserving surgery of the hip.

Where Do We Need To Go?

Intraoperative imaging assessment of proper femoral head anterior coverage and acetabular version after reorientation of the osteotomized fragment can be more challenging than assessment of femoral head lateral coverage. The way we use conventional fluoroscopic imaging to assess anterior coverage of the femoral head and acetabular version during hip surgery exposes surgeons to a wide range of potential methodological errors (patient and fluoroscope positioning, pelvic tilt, image calibration and magnification). Currently, full-pelvis plain radiographs in the supine position are the best test for intraoperative assessment of proper correction of deformity [7]. Wylie and colleagues identified further areas of research evaluating the correlation between intraoperative fluoroscopic images and plain radiographs in the assessment of femoral head anterior coverage and acetabular version. This will require a large sample size and a reproducible methodology, though it should be a rather straightforward research project for a high-volume hip joint preserving surgery team. However, I believe the real opportunity in this field of research is computer-assisted CT-fluoroscopy imaging. This innovative technology is currently used in clinical practice for placement of percutaneous screws in pelvic and acetabular fracture fixation [13], bone-tumor surgery [11], and pedicle screw placement in the spine [3]. Computer-assisted CT-fluoroscopy can potentially offer precise navigation while carrying out the periacetabular osteotomies, as well as provide three-dimensional images while repositioning the acetabular fragment.

How Do We Get There?

Initially, computer-assisted systems designed to support surgeons carrying out pelvic osteotomies for the treatment of dysplastic hips were based on preoperative CT imaging and freehand navigation with optoelectronic trackers. The early systems supported the preoperative plan and provided enhanced control during the execution of the required osteotomies [7]. More recently, navigation technologies developed for PAO incorporated intraoperative fragment tracking and positioning characterization to assess the reorientation of the acetabulum [8]. Prior work has concluded that navigation and visualization with computer-assisted aids obtained accurate postoperative radiographic correction when compared with conventional techniques carried out by high-volume experienced surgeons [5].

Meanwhile, the new frontier has moved toward CT-fluoroscopically assisted computer navigation. In pelvic trauma surgery, the fluoroscopic-assisted procedure of percutaneous screw placement is carried out using preoperative CT scans referenced to intraoperative fluoroscopic images using a matching algorithm registration kit mounted on the image intensifier of the C-arm. For an accurate matching process, the system requires at least two fluoroscopic images with a minimum of a 30° angle difference between the images. The navigation system offers the possibility to evaluate the precision of the registration process by aiming with the pointer tool at the surface of different anatomical landmarks of the pelvis [13]. A recent cadaver study showed high accuracy of CT-fluoroscopy navigated K-wires for guidance of supra-acetabular osteotomies [10].

We need further development and validation of computer-assisted CT-fluoroscopic technology. Once PAO-specific navigation systems are available and thoroughly validated, their

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real potential will be tested in the clinical practice. At worst, CT-fluoroscopy in PAO will be used merely for teaching purposes, and to shorten the steep, long learning curve of young surgeons. At best, this technology will take over the current conventional intraoperative imaging; to me, this trend is already noticeable in pelvic trauma and spine surgery.

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