Posterior wall acetabular fractures that involve 10% to 40% of the posterior wall may or may not require an open reduction and internal fixation. Dynamic stress examination of the acetabular fracture under fluoroscopy has been used as an intraoperative method to assess joint stability. The aim of this study was to demonstrate the value of intraoperative ISO computed tomography (CT) examination using the Siemens ISO-C imaging system (Siemens Corp, Malvern, Pennsylvania) in the assessment of posterior wall acetabular fracture stability during stress examination under anesthesia. In 5 posterior wall acetabular fractures, standard fluoroscopic images (including anteroposterior pelvis and Judet radiographs) with dynamic stress examinations were compared with the ISO-C CT imaging system to assess posterior wall fracture stability during stress examination. After review of standard intraoperative fluoroscopic images under dynamic stress examination, all 5 cases appeared to demonstrate posterior wall stability; however, when the intraoperative images from the ISO-C CT imaging system demonstrated that 1 case showed fracture instability of the posterior wall segment during stress examination, open reduction and internal fixation was performed. The use of intraoperative ISO CT imaging has shown an initial improvement in the surgeon’s ability to assess the intraoperative stability of posterior wall acetabular fractures during stress examination when compared with standard fluoroscopic images.
Posterior wall acetabular fractures are the most common injury pattern, comprising as much as one-third of all acetabular fractures.1-3 While many acetabular fractures can be assessed using roof arc angles, posterior wall fractures lay outside the planes of measurement.3 The degree of posterior wall involvement has been quantified using computed tomography (CT), which can assess both fracture size and amount of marginal impaction.4 In general, posterior wall acetabular fractures that involve more than 40% of the posterior wall will be unstable and those that involve less than 20% will be stable,5,6 although using a measurable percentage as a marker for stability alone has been shown to be rather unreliable.7

No clear nonoperative or operative guidelines exist for acetabular fractures that demonstrate 20% to 40% posterior wall injury.8 A dynamic stress examination of the acetabular fracture under fluoroscopy has been used as an intraoperative method to determine the stability and congruity of the posterior wall fracture to determine whether it may be treated nonoperatively or operatively.9 However, there are inherent problems using fluoroscopy to assess 3-dimensional structures10 because the image is 2-dimensional and the structures of interest are the femoral head and the acetabulum. The use of CT imaging and ISO-C (Siemens Corp, Malvern, Pennsylvania) reconstructions has been shown to be extremely helpful for posterior wall acetabular fracture classification as well as preoperative planning and postoperative evaluation of the fracture reduction.11 The purpose of this study was to evaluate the use of intraoperative ISO CT for assessing the stability of posterior wall acetabular fractures. To the authors’ knowledge, there are no published studies in the orthopedic literature evaluating the role of intraoperative ISO CT for the evaluation of posterior wall acetabular fracture stability or instability.

**MATERIALS AND METHODS**

Fifteen acetabular fractures were evaluated and treated with various techniques with intraoperative ISO CT examination review of the acetabular fractures. Five of the 15 acetabular fractures were posterior wall fractures that involved 40% or less of the posterior wall. In these 5 posterior wall acetabular fractures, standard fluoroscopic images (including anteroposterior pelvis and Judet radiographs) with dynamic stress examinations were compared with the ISO-C CT imaging to assess posterior wall fracture stability during stress examination.

All 5 patients with posterior wall acetabular fractures were positioned supine on a radiolucent operative table. Standard anteroposterior pelvis and Judet fluoroscopic images were taken. The static images were then compared with the anteroposterior pelvis and Judet images while a dynamic stress was applied. After comparison of the static and dynamic images, the primary surgeon (G.O.) determined if the images demonstrated a stable or unstable posterior wall fracture. In these 5 cases, the primary surgeon determined that all 5 acetabular fractures appeared to be stable and appropriate for nonoperative management.

After completion of all static and dynamic images, ISO-C CT imaging was used by assessing the acetabular fracture during a dynamic stress examination. The position of the patient’s hip during the stress examination is shown in Figure 1. During the ISO-C CT image sequence, the surgeon applied a dynamic stress to the hip by applying force to the leg with the hip flexed 45°. To help minimize radiation exposure, the surgeon stood at the foot of the bed applying force through the leg during both the fluoroscopic imaging and ISO-C CT imaging.

**RESULTS**

After review of intraoperative, standard fluoroscopic images under dynamic stress examination, 5 of 5 cases seemed to demonstrate posterior wall stability and were not worthy of open reduction and internal fixation. An example of an ISO-C image sequence demonstrating a stable posterior wall fracture is presented in Figure 2. However, after these cases

![Figure 1: The intraoperative setup for stress examination of a right acetabular fracture.](image1)

![Figure 2: Intraoperative computed tomography images of a posterior wall fracture under stress examination. Three successive images demonstrate posterior wall stability under stress examination: static (A), dynamic stress (B), and dynamic stress at 45° (C).](image2)
were determined to be stable via the standard fluoroscopic images, the intraoperative images obtained using the ISO-C CT imaging system demonstrated that 1 case showed fracture instability of the posterior wall fracture segment during stress examination. In this case, open reduction and internal fixation was performed.

In the other 4 cases, the ISO-C CT imaging system confirmed the stability of the posterior wall fractures as viewed during fluoroscopic review during stress examination.

**DISCUSSION**

Posterior wall fractures present a unique challenge to orthopedic surgeons because of the contribution of the posterior acetabulum to hip stability. Numerous techniques and strategies have been devised to quantify the operative indications for posterior wall fractures. Roof arc angles have been used effectively to evaluate acetabular fractures; however, this technique is not capable of evaluating posterior wall fractures because the fractures are outside of the radiographic plane. Computed tomography has been advocated as a system to stratify posterior wall fractures into stable and unstable cohorts based on the size and location of the fragment. These characteristics of the fragment have a relationship to the stability of the hip; however, this method is both an indirect and static technique for assessing femoral–acetabular stability. Dynamic stress views of the hip have been described as a more accurate way to determine stability, offering direct visualization of the hip under physiologic stress. Recently, the accuracy of 3 methods for using CT to predict hip stability in posterior wall fractures was examined by comparing the method of Keith et al, that of Calkins et al, and an alternative method developed by Moed et al with an examination under anesthesia. While the method Moed et al demonstrated improved accuracy compared with the 2 previously described techniques, this method classified 70% (23 of 33 patients) of the fractures as indeterminate and further highlights the need for direct visualization in the operative evaluation for a majority of posterior wall fractures.

The current study examined a group of posterior wall fractures, those greater than 20% and those less than 50%, that have traditionally been classified as warranting an examination under anesthesia for surgical evaluation, which was further supported by recent studies. The outcome after nonoperative treatment of acetabular fractures depends on the stability of the hip, the concentricity of the head under the roof of the acetabulum, and the condition of the roof. Computed tomography can assess the concentricity of the femoral head in the acetabulum and evaluate the condition of the acetabular dome, but cannot directly examine the stability of the hip joint. Multiple studies have shown increased sensitivity to malreduction and small articular stepoffs with CT compared with radiographs. Additionally, ISO CT has been shown to be superior to traditional fluoroscopy in multiple settings examining fracture reduction. By comparing the results of dynamic fluoroscopy with ISO-C CT imaging, the current authors found that a significant proportion of the hip joint that appears stable with fluoroscopy may have posterior wall fragment motion and low-level instability as well as suboptimal femoral head–acetabular congruity.

The authors’ initial use of intraoperative ISO CT imaging has shown an initial improvement in the surgeon’s ability to assess the intraoperative stability of posterior wall acetabular fractures during stress examination when compared with standard fluoroscopic images. Thus far, the authors feel the Siemens ISO-C CT imaging system may be helpful for orthopedic surgeons to determine if some posterior wall acetabular fractures may be stable or unstable. The authors are continuing the evaluation of posterior wall acetabular fractures with both techniques to further assess the validity of this novel technique using ISO CT intraoperative imaging.

**REFERENCES**


