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Surgical results and factors influencing outcome in patients with posterior wall acetabular fracture

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ABSTRACT

The purpose of this study was to evaluate the results of open reduction and internal fixation in a large series of posterior wall fractures of the acetabulum and to identify the factors that affect the outcomes in this case series. One hundred twenty-one patients who had undergone open reduction and internal fixation of a fracture of the posterior wall of the acetabulum were assessed at a mean of 53 months (range, 24–163) after surgery. The functional outcome was evaluated with use of the modified Merle d'Aubigne scoring system, the Harris Hip Score (HHS), and the Short Form-36 Health Survey (SF-36) questionnaire. Final follow-up radiographs were graded according to Matta's radiologic criteria. Patient, fracture, and radiographic variables were analyzed to identify possible associations with functional and radiographic outcome. The quality of fracture reduction on postoperative radiographs was anatomical in 115 hips (95.0%), satisfactory in 6 cases (5.0%), and unsatisfactory in none. Final modified d'Aubignè scores were excellent in 45 hips (40.2%), good in 52 (46.4%), fair in 7 (6.3%), and poor in 8 (7.1%). Mean HHS was 91.5 ± 8.9 (48–100). The SF-36 scores were similar with respect to age and sex-matched norms, but physical domains in males remained lower in comparison with the normal population. The early reduction of an associated hip dislocation and quality of surgical reduction were strong positive predictors of functional and radiographic outcomes at follow-up, whereas associated injuries and the existence of pre-operative nerve palsy were negative predictors of patients' functionality. This study of surgically treated fractures of the posterior wall of the acetabulum has shown that functional and radiographic results are satisfactory in most patients, provided that prompt reduction of an associated hip dislocation and anatomical reduction of the fracture are carried out. Associated injuries and nerve lesions affect the final functional outcome.

Introduction

Fractures of the posterior wall, which account for approximately one-fourth of all acetabular fractures [1,2], are often associated with hip dislocation. These injuries most frequently occur in young and active subjects and are usually caused by high impact trauma, particularly road traffic accidents [2,3]. Two distinct anatomo-radiographic patterns can be found in posterior wall acetabular fractures [1,4]. Most commonly, one or several free fragments are separated from the posterior column. Less frequently, in addition to the previous lesion, marginal impaction of the inner part of the posterior wall may occur in the underlying cancellous bone.

Displaced fractures of the posterior wall of the acetabulum should be reduced surgically to ensure a painless, mobile, and stable hip. However, previous published data have shown that a significant portion of operatively treated patients obtains poor outcomes despite the relatively simple fracture pattern [5,6]. Surgical outcomes can be influenced by the presence of several factors, including older age at the time of injury [6], the status of the femoral head [7,8], cancellous impaction of fracture fragments [9–11], and intra-articular comminution of the fracture [5,6]. Further, delays in hip dislocation [6], the quality of reduction [1,7,12], and associated injuries [13,14] are also associated with poor functional outcomes. Late complications, such as the osteoarthritis (OA), avascular necrosis of the femoral head

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(AVN), and heterotopic ossification (HO) may also compromise long-term outcomes despite proper fracture reduction [15].

To further compound these challenges is the fact that most of the studies that have reported the surgical results and assessed the potential prognostic factors specifically in fractures of the posterior wall of the acetabulum have been based upon relatively small case series, thereby producing less reliable analyses. Moreover, there is a paucity of published data on patients'satisfaction and self-reported health-related quality of life (HRQoL) as assessed by validated instruments [16]. Accordingly, to improve treatment algorithms, it would be helpful if surgeon-oriented measurements of pain and disability were integrated with an evaluation of the general health status as perceived by patients.

In an effort to fill the void in the clinical and investigational literature on the outcomes of patients with fracture of the posterior wall of the acetabulum, we set out 1) to evaluate the results of open reduction and internal fixation (ORIF) in a large series of posterior wall fractures of the acetabulum by using validated instruments as well as an HRQoL assessment, and 2) to identify the factors that most likely affect the outcomes in this case series.

Materials and methods

One hundred and fifty patients were treated with ORIF for a displaced fracture of the posterior wall of the acetabulum between 1999 and 2014. Indications for operative treatment were an intra-articular displacement of more than 2 mm, the presence of fragments inside the joint space and/or marginal impaction injury, and/or the lack of containment of the femoral head. All surgeries were performed by one single surgeon (RP). Preoperative radiographic evaluation included an anteroposterior view and two Judet 45° oblique radiographs of the pelvis. In all patients, a computed tomography (CT) scan of the pelvis with 3D reconstruction was also performed in the initial imaging evaluation phase to obtain a more accurate characterization of the fracture. In patients with hip dislocation, instead, a second CT scan was performed after closed reduction of the dislocation to assess the adequacy of reduction, as well as the presence of osteochondral free fragments inside the joint space requiring surgical removal, marginal impaction injury, or injury of the femoral head. On the basis of Judet's classification system [1,4], the fractures were divided into type 1 and type 2, depending on the presence or absence of marginal impaction injury. Surgical treatment was performed as soon as the patient's general medical condition allowed. Sometimes, treatments were delayed because patients had to be transferred from a referring institution. The Kocher–Langenbeck approach was used for all patients. When marginal impaction of a fragment was present, the impacted articular cartilage was elevated and reduced to its anatomic position over the femoral head, which served as a template. The resulting defect was filled with cancellous grafts harvested from the greater trochanter. In 4/150 cases (2.7%), a trochanteric flip osteotomy [17] was performed. Associated fractures of the femoral head were managed with removal of fragment or fixation with screws. Fixation was performed when fractures displayed one simple large fragment. Once acceptable reduction of the posterior wall of the acetabulum was obtained, definitive fixation of the fracture was performed using cancellous interfragmentary screws and reconstruction plates. In all patients, preoperative antibiotic prophylaxis and post-operative thrombo-prophylaxis with low molecular weight heparin were used. No prophylaxis against HO was routinely administered. Postoperatively, three standard radiographic views of the pelvis were made to assess fracture reduction. The maximum displacement seen at any of the normal radiographic lines of the acetabulum or the femoral head was used to grade the reduction according to one of three categories: anatomical (displacement = 0–1 mm), satisfactory (2–3 mm), or poor (more than 3 mm) [7]. Post-operative rehabilitation protocol was started as soon as the patients' medical conditions permitted. It included muscle-strengthening and active range-of-motion exercises. Weight bearing on the operated limb was restricted for 12 weeks. Subsequent progression to full weight-bearing was individualized. The time interval between injury and reduction of associated dislocation and ORIF, as well as all possible in-hospital postoperative complications, were recorded at discharge.

After discharge, patients underwent clinical and radiographic clinical examination at six months, one year, and annually thereafter. Files containing follow-up information were updated after each follow-up visit. Although only a few patients were examined at all of the follow-up intervals, all of them were examined at the final interval.

The data collected from the final follow-up were used for this study. Out of 150 patients participating in the study, two died from unrelated causes less than two years after surgery and 27 were lost to follow-up, leaving 121 subjects available for the follow-up (survey rate = 80%). No significant differences with respect to age ($P = 0.24$), sex ($P = 0.18$), body mass index (BMI)($P = 0.30$), associated injuries ($P = 0.57$), quality of surgical reduction ($P = 0.86$), or surgical delay ($P = 0.99$) were found between participants and subjects lost to follow-up.

At the time of the final follow-up, which occurred after a minimum interval of two years after surgery, the patients gave their informed consent to undergo clinical and radiographic examination. The clinical examination was carried out by one of the authors (SC) uninvolved in the surgical treatment of patients. Information regarding possible implant and medical complications, as well as possible reoperations that had occurred in the previous time interval, was collected during the follow-up visit. The instruments chosen to evaluate outcomes at the final follow-up were the modified Merle d'Aubigne scoring system [7], the Harris Hip Score (HHS) [18], and the Short Form-36 Health Survey (SF-36) questionnaire (to evaluate the generic HRQoL) [19]. More specifically, the modified Merle d'Aubigne hip scoring system assigns a maximum score of 6 points to pain, gait, and ROM. A point score of 18 corresponds to the best outcome. Similarly, the HHS is an instrument widely used to assess pain and functional status. The SF-36 Questionnaire, instead, is a generic health status measure comprising 36 questions that measure the physical, social, and mental components of patients. In this study, the SF-36 results were compared to the reference data for healthy subjects [20]. The minimal clinically important differences (MCID) with normative data were 6 to 7 points [21]. Pain and Treatment Satisfaction variables were also evaluated using a visual analog centesimal scale. Final follow-up radiographs were graded according to Matta's radiologic criteria that score arthritic changes in the hip joint [7]. Evidence of AVN or HO was also assessed using these follow-up radiographs. HO was classified according to Brooker et al. [22].

Statistical analysis

A two- sample *t* test, chi-square test, and Fisher's exact test were used to test the significance of the cross-sectional differences between groups. Pearson's correlation coefficient was used to assess relationships between functional and radiographic outcomes. Age-adjusted univariate and forward stepwise multiple logistic regression analyses were used to determine whether explanatory variables were significantly associated with the following endpoints: secondary total hip arthroplasty (THA), OA, and AVN. Age-adjusted univariate and multiple forward stepwise linear regression analyses were also used to assess the association