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Functional outcomes more than 5 years following acetabulum fracture

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Abstract

Objectives: The purposes of this project were to evaluate functional outcomes more than 5 years after acetabulum fracture and to determine factors related to function.

Methods: This retrospective study consisted of 205 adult patients treated for acetabulum fracture who completed the Musculoskeletal Function Assessment (MFA) a minimum of 5 years following injury. The MFA includes survey of daily activities, gross and fine mobility, social and work function, sleeping, and mood. Higher scores indicate worse function.

Results: Two hundred five patients with 210 fractures, 69.3% of whom were male, with mean age of 45.7 and mean body mass index 30.1 were included after mean 128 months follow-up. Fracture patterns included OTA/AO 62A (37.1%), 62B (40.5%), or 62C (22.4%), and 80.0% were treated surgically. Late complications were noted in 35.2%, including posttraumatic arthrosis (PTA: 19.5%), osteonecrosis and/or heterotopic ossification. Mean MFA of all patients was 31.4, indicating substantial residual dysfunction. Worse MFA scores were associated with morbid obesity (body mass index >40: 42.3, $P>.09$), and current tobacco smoking history vs former smoker vs nonsmoker (45.2 vs 36.1 vs 23.0, $P<.002$). Patients with late complications had worse mean MFA scores (38.7 vs 27.7, $P=.001$); PTA was the most common late complication, occurring in 19.5%.

Conclusions: More than 5 years following acetabulum fracture, substantial residual dysfunction was noted, as demonstrated by mean MFA. Worse outcomes were associated with late complications and tobacco smoking. While fracture pattern was not associated with outcome, those patients who had late complications, mostly PTA, had worse outcomes.

1. Introduction

Acetabulum fractures are often high-energy injuries in younger patients, and as such, they usually occur with other injuries. Regarding elder patients, a growing number are also sustaining high-energy trauma, as life expectancy has increased, and effectiveness of trauma systems has also improved. However, most acetabulum fractures in elder patients still occur secondary to low-energy falls. In developed countries, the incidence of high-energy fractures, often treated surgically, has been decreasing, while the incidence of low-energy fractures is increasing.[1–3]

While there are multiple variables that may affect recovery such as type of injury and treatment, baseline medical and psychosocial status likely have an important impact on recovery and long-term function.[4–6] A paucity of data have been published regarding patient-reported functional outcomes. Much of the existing literature is limited by poor scientific rigor of previously utilized outcomes instruments.[7] However, some of the modern generalized musculoskeletal instruments have demonstrated validity based on physical components of scores.[7,8] The purpose of this project was to evaluate functional outcomes more than 5 years after acetabulum fracture in a large sample of patients treated at a single institution, and to determine factors related to function. We hypothesized that the severity of injury, late complications, and underlying social factors would impact scores on self-reported functional assessment questionnaires.

2. Patients and methods

Adult patients treated for acetabulum fracture between 2000 and 2013 at a single level 1 trauma center were identified from a fracture registry. Institutional Review Board approval was obtained. All 765 patients with 779 fractures that were treated either nonoperatively or operatively with open reduction and internal fixation (ORIF) and had survived their initial hospital stay with a minimum of 5 years since date of injury were included. Demographic data, social history, injury features, and treatment details were abstracted from the medical record. Plain radiographic images and CT scans of the pelvis were reviewed to

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provide OTA/AO and Letournel classifications of fractures.[9–11] Clinical and radiographic records were reviewed to detect complications related to injury and treatment, including early complications: surgical site infection, thrombotic complications; and late complications: posttraumatic arthrosis (PTA), osteonecrosis, and heterotopic bone formation. Surgical site infection was defined as erythema and/or purulent drainage at the surgical site. Thrombotic complications included deep venous thrombosis noted at or proximal to the knee and pulmonary embolism. Arthrosis was defined as any joint space narrowing, subchondral sclerosis, subchondral cysts, and/or osteophyte formation. Osteonecrosis was defined as subchondral sclerosis and collapse of the femoral head. Heterotopic bone was defined by any new ossification around the hip joint. Secondary procedures were documented. A minimum of 12 months of follow-up was required to assess patients clinically and radiographically for these complications.

Patients were contacted by a trained researcher not involved in their care to obtain functional outcomes surveys after minimum 5 years following injury. Contact was attempted via telephone or mail, or during a scheduled clinic visit. Functional outcomes were evaluated with the Musculoskeletal Function Assessment (MFA), a general health status measure.[12] The MFA has 10 categories: mobility, hand and fine motor function, housework, self-care, sleep and rest, leisure and recreation, family relationships, cognition and thinking, emotional adjustment and adaptation, and employment. The reliability, validity, consistency, and responsiveness of the MFA has been described.[12–14] Overall MFA scores range from 0 to 100, with low scores indicating better function.

Clinical outcome variables included complications and secondary procedures. Functional outcomes included MFA scores. Possible predictive variables included fracture features (fracture pattern, marginal impaction, femoral head injury, history of dislocation), treatment, age, sex, BMI, Injury Severity Score (ISS), associated injuries (head, chest, abdomen, spine, extremity), and complications. A t test was used to identify associations between MFA scores and possible predictive variables. The t test or analysis of variance was used to identify associations between the functional outcomes and the clinical outcomes. In all cases, $P < .05$ was considered significant.

3. Results

After a minimum of 5 years follow-up from acetabulum fracture 205 patients sustaining 210 fractures (5 patients sustained bilateral acetabular fractures) completed the MFA after mean 128 months follow-up (range: 60–219 months). The remaining 560 patients did not complete a survey: 88 patients were deceased, 6 declined, and 371 could not be reached, while 95 patients completed MFAs earlier than 5 years. In comparison with the initial group, those who completed the MFA were older at the time of injury (45.7 vs 43.4 years, $P = .15$), and were more often female (29.7% vs 25.9%, $P = .23$), though not statistically significant (Table 1). Although the frequency of isolated injuries among the study group was no different (23.9% vs 25.5%), mean ISS was higher in the study group (23.1 vs 20.4, $P = .004$). The study group also had a lower incidence of OTA/AO type A patterns (37.1% vs 46.9%, $P < .001$). No differences were identified between the 2 groups with respect to mechanism, Letournel pattern, or other features of the injury.

The majority of patients completing MFA surveys were injured in a motor vehicle collision (62%) or fall from a height greater than 3 feet (14%). Most common fracture patterns were posterior wall (22%), transverse with posterior wall (19%), and associated both column fractures (16%). However, low-energy falls occurred in 14 fractures (6.8%), and 71% of these patients had isolated acetabular fractures. Fracture patterns and features of the acetabulum fractures are shown in Table 1.

Mean MFA for the entire group of 205 patients was 31.4, substantially worse than an uninjured reference sample population (9.3, $P < .0001$).[14] Men had a trend toward lower MFA scores suggesting better outcomes than females (29.7 vs 35.2, $P = .13$) (see Table 2). Age when injured was not associated with MFA score. However, morbid obesity was associated with a trend toward worse outcome scores, as those with BMI >40 had mean MFA of 42.3 vs 35.7 (30–40) vs 31.5 (<30), $P = 0.09$. The minority of patients were tobacco smokers (15%). 27.8% of patients were current smokers, 16.6% former smokers, and 33.2% nonsmokers. Patients who were never tobacco smokers had better functional outcomes with lower mean MFA than their counterparts (23.0, $P < .002$).

One hundred sixty-eight (80%) were treated with ORIF, while the others were managed nonoperatively. No difference was seen in outcomes when patients treated operatively were compared with those having nonoperative management. Neither ISS nor history of multiple (versus isolated) injuries was associated with outcome scores. Furthermore, fracture pattern, presence of associated dislocation, marginal impaction, or femoral head injury were not associated with MFA scores (Table 2).

Surgical complications were identified in 82 patients (40%). Twenty-five (12.2%) experienced early complications with 1 patient experiencing 2 early complications, and 74 patients (35.2%) had late complications. Of note, 14 patients (6.8%) had both early and late complications. Early complications included superficial infection (0.5%), deep infection (1.5%), DVT (9.3%), and pulmonary embolism (2.0%). None of these had an impact on functional outcome (Table 3), possibly due to small sample size. Overall, patients with early complications had mean MFA of 37.8 (vs 30.5, $P = .24$).

However, those with late complications had worse mean MFA scores (38.7 vs 27.7, $P = .001$). Among these, 19.5% developed PTA, 18.6% had heterotopic ossification (HO), and 4.8% had osteonecrosis. Patients with fractures which developed PTA had worse outcomes (38.0 vs 30.0, $P = .06$), as did those who developed HO (41.7 vs 29.2, $P = .004$). Twenty-two patients underwent THA for pain relief, but their MFA scores did not show improvement. Sixteen had repeat MFA after THA (mean 34.6 versus 43.3 (n = 6)).

4. Discussion

The purposes of this project were to evaluate functional outcomes more than 5 years after acetabulum fracture and to determine factors related to function, as reported by patients who completed the MFA. Overall the mean MFA score of 31.4 indicated substantial residual dysfunction compared with an uninjured reference value of 9.3 ($P < .0001$).[14] Furthermore, the published mean MFA reference value 1 year after hip injury is 25.5, again significantly better than the mean of our group ($P < .0001$).[14] Other authors have noted poor mean scores on the MFA (ranging from 25 to 36)[5,6,15] or SF-36,[16–18] although few have reported outcome more than 5 years after injury.[16]

This study objectively evaluated multiple patient characteristics and injury features to assess for associations with outcome. Fracture pattern, specific features of the acetabulum fracture, and

Table 1

Demographic and injury features are listed, including mean values as indicated or the total number of persons or fractures and percent of total

	Study population (n=205 patients with 210 fractures)	Excluded patients (n=560 with 569 fractures)	*P* value
Mean age (years)	45.7	43.4	.15
<40 years	75 (36.6%)	269 (48.0%)	.009
40–60 years	90 (43.9%)	187 (33.4%)	
>60 years	40 (19.5%)	104 (18.6%)	
Male	142 (69.3%)	415 (74.1%)	.23
Mean BMI	30.1	30.2	.91
Mean ISS	23.1	20.4	.004
Mechanism of injury			
Motor vehicle collision	127 (62.0%)	354 (63.2%)	.51
Motorcycle crash	13 (6.3%)	47 (8.4%)	
Fall from height	29 (14.2%)	58 (10.4%)	
Fall from stand	14 (6.8%)	61 (10.9%)	
Other	22 (10.7%)	40 (7.1%)	
Fracture pattern: AO/OTA			
62A	78 (37.1%)	267 (46.9%)	<.001*
62B	85 (40.5%)	204 (36.4%)	
62C	47 (22.4%)	95 (16.7%)	
Fracture pattern: Letournel			.29
Posterior wall	46 (21.9%)	166 (29.3%)	
Posterior column	3 (1.4%)	13 (2.3%)	
Posterior column and wall	19 (9.1%)	51 (9.0%)	
Transverse	15 (7.1%)	46 (8.1%)	
Transverse and post wall	39 (18.6%)	96 (17.1%)	
T	20 (9.5%)	43 (7.6%)	
Anterior wall	0	6 (1.1%)	
Anterior column	11 (5.2%)	29 (5.1%)	
Anterior column posterior hemitransverse	23 (11.0%)	43 (7.6%)	
Associated both column	34 (16.3%)	75 (13.3%)	
Injury features:			
Posterior dislocation	90 (42.9%)	247 (43.4%)	.87
Femoral head injury	17 (8.1%)	49 (8.6%)	.72
Marginal impaction	34 (16.2%)	99 (17.4%)	.92
Isolated acetabulum fracture	49 (23.9%)	143 (25.5%)	.54

Column 1 represents the study population with functional outcomes data more than 5 years after injury. Column 2 shows the excluded patients for comparison.
BMI = body mass index; ISS = Injury Severity Score; OTA/AO = fracture classification as described by the OTA/AO.
* Comparison vs both other groups.

ISS were not related to mean MFA scores, in contrast to other authors.[5,6,19] Kreder et al reported MFA and SF-36 scores after minimum 1 year follow-up for surgically treated posterior wall fractures. Patients with marginal impaction or associated (versus simple) patterns had worse scores.[5] It may be that after a longer period of follow-up patients have adapted to their functional situation, and that the initial injury details seemingly have less impact over time.[20,21]

We observed a trend for women to report worse outcomes than men. Other authors have described worse self-reported outcomes in women when compared with men, irrespective of type and severity of injury.[22–27] Variations in culture and socialization may account for differences in reporting based on sex. Contrary to some other reports, we did not observe an effect of age on outcome scores. Prior authors have speculated that in older patients, adaption of expectations occurs along with less strenuous physical needs, resulting in less likelihood to report dysfunction.[24,28–30]

Recently, attention has been given to the unique challenges of managing obese patients with acetabulum fractures. Longer surgical times and poor access and visualization may result in fewer anatomic reductions.[31,32] Early and late complications appear more likely in the obese population.[31–35] Additionally, morbidly obese patients may have worse functional status at baseline, which would predispose to worse survey scores years later.[36,37] Our finding of a trend toward higher mean MFA scores in morbidly obese patients is consistent with these possibilities. Our group of patients with BMI >40 was small, limiting our power to analyze them effectively. Patient education about the impact of high BMI on functional outcome scores may encourage patients to pursue weight loss.

Tobacco smoking was associated with worse outcomes with higher MFA scores than their counterparts. Regarding the deleterious biological and social consequences of tobacco smoking on healing and recovery after major fractures, much has been written.[36–42] Tobacco smokers may have less functional capabilities at baseline, along with reduced capacity for healing and recovery of ambulatory and other functions.[43] Recent reports further suggest that tobacco smoking has effects on intensity of pain and on the incidence of various other mental symptomatology, including depression and anxiety, all of which are likely to impact functional outcome scores.[28,29,36,44,45] Cessation of tobacco smoking should be encouraged; although we are not able to report on potential improvement in functional outcomes following tobacco cessation.

After a minimum of 5 years follow-up complications from the early postinjury period did not have a significant impact on mean MFA scores. This is not surprising, as these issues are likely to be

Table 2

Functional outcome scores as measured by the Musculoskeletal Function Assessment (MFA)

	n	Mean MFA score	*P* value
Male	142 (69.3%)	29.7	.13
Female	63 (30.7%)	35.2	
Age <40 years	75 (36.6%)	33.0	
Age 40–60 years	90 (43.9%)	31.4	
Age >60 years	40 (19.5%)	28.3	.48†
BMI<30	77 (53.8%)	31.5	
BMI 30–40	48 (33.6%)	35.7	
BMI >40	18 (12.6%)	42.3	>.09†
Current smoker	57 (35.8%)	45.2	
Former smoker	34 (21.4%)	36.1	
Nonsmoker	68 (42.8%)	23.0	<.002†
Fracture pattern:			
62A	78 (37.1%)	27.9	
62B	85 (40.5%)	34.9	.07*
62C	47 (22.4%)	31.6	.39*
Low-energy injury	36 (17.6%)	33.7	.29
High-energy injury	169 (82.4%)	30.9	
Operative	168 (80.0%)	32.1	.45
Nonoperative	42 (20.0%)	29.5	
Isolated injury	49 (23.9%)	35.1	.22
Multiple injuries	156 (76.1%)	30.2	
ISS<24	71 (56.8%)	32.7	.97
ISS≥24	54 (43.2%)	32.8	
Injury features:			
Posterior dislocation	90 (42.9%)	28.1	.62
Femoral head injury	17 (8.1%)	30.9	.84
Marginal impaction	34 (16.2%)	29.1	.60

Mean scores are shown for patients with various demographic, social, and injury features.
BMI = body mass index; ISS = Injury Severity Score.
* Comparison vs A patterns.
† Comparison vs both other groups.

Table 3

Complications and secondary operations

	n	Mean MFA score	*P* value
Early complications	25 (12.2%)	37.8	.24
None	180	30.5	
Superficial infection	1 (0.5%)	47.0	
Deep infection	3 (1.5%)	37.7	.49
None	203 (98.0%)	31.2	
DVT	19 (9.3%)	34.3	.57
No DVT	188 (90.7%)	31.0	
PE	4 (2.0%)	38.0	.52
No PE	201 (98.1%)	31.3	
Late complications	74 (35.2%)	38.7	.001
None	136 (64.8%)	27.7	
PTA	41 (19.5%)	38.0	.06
No PTA	169 (80.5%)	30.0	
Osteonecrosis	10 (4.8%)	45.8	.06
No osteonecrosis	200 (95.2%)	30.8	
HO	39 (18.6%)	41.7	.004
No HO	171 (81.4%)	29.2	
Secondary operation	39 (18.6%)	36.5	.16
No secondary operation	173 (81.4%)	30.4	

DVT = deep vein thrombosis; HO = heterotopic ossification; PE = pulmonary embolism; PTA = posttraumatic arthrosis.

resolved within the several months following injury and are unlikely to generate later medical or functional consequences. Another instrument specific to hip function may have been more able to detect differences among patients. In contrast, late complications, especially PTA and HO, were associated with very poor mean MFA scores, which is consistent with other studies with shorter follow-up.[5,6,46,47] Our study is limited in that we did not attempt to determine impact of secondary procedures for pain relief, specifically THA, on functional outcome scores. We did not assess potential influence of fracture pattern or of reduction quality on development of PTA; however, it is well established that fracture patterns, involving posterior wall or dome impaction or comminution, are more likely to result in PTA.[5,6,18,48–50] Reduction quality also plays a key role in mitigating PTA.[5,6,15,16,18] Our data also showed no differences in MFA scores when operative and nonoperative patients were compared; however, this probably reflects that nonoperative patients had less displaced fractures, which portend a better long-term prognosis. Displaced fractures when treated surgically overall appear to have similar mean functional outcomes, indicating the value of reduction and fixation in improving function.

Other limitations to this study include a large percentage of patients who were lost to follow-up, possibly following up at other institutions whose records would not be seen within our electronic medical record. Furthermore, patients experiencing difficulties, whether from their acetabulum or from other injuries, could be more likely to follow up and report dysfunction. We noted the initial group had lower ISS and a trend toward more isolated injuries. However, this paper does have a large sample, with moderate mean follow-up, and it adds to the small body of existing literature on this topic, in a time where increasing emphasis is being placed on patient-reported outcomes.

After minimum 5-year follow-up from acetabulum fracture, functional limitation was observed frequently according to self-reported MFAs. Worse functional outcomes were associated with late complications, morbid obesity, and tobacco smoking. While fracture pattern was not associated with outcome, those patients who had late complications, mostly PTA and HO, had worse outcomes. This information will aid in counseling patients with underlying risk factors, such as obesity and tobacco smoking about effects on function more than 5 years following injury.

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