Intentional fallers with complex pelvic and acetabular fractures do not have worse radiological and functional outcomes than accidental fallers

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Abstract

Intentional fallers with complex pelvic and acetabular fractures were thought to have a worse prognosis because of their mental disorders. We aimed to investigate the clinical outcomes of fallers with pelvic and acetabular fractures after osteosynthesis surgeries and to compare the radiological and functional outcomes between intentional and accidental fallers.Methods Between 2014 and 2017, fallers with complex pelvic and acetabular fractures who survived from resuscitation and complete surgical treatments were enrolled and investigated.Results Forty-nine fallers who underwent osteosynthesis for pelvic and acetabular fractures were included. Sixteen patients were intentional fallers, whereas the rest of the patients fell accidently. All patients who fell intentionally had pre-existing mental disorders, and the major diagnosis was adjustment disorder. Intentional fallers presented with younger age, higher injury severity score and new injury severity score, longer intensive care unit and hospital stay, early loss to follow-up, and worse functional outcomes at the 6-month follow-up. However, the radiological and functional outcomes at the 12-month follow-up did not significantly differ between the intentional and accidental fallers.Conclusion In conclusion, the intentional fallers with complex pelvic and acetabular fractures may have worse clinical presentations initially, but their radiological and functional outcomes may become comparable to those of accidental fallers after treatments.

Background

The optimal treatment of pelvic and acetabular fractures is still challenging for orthopedic surgeons, especially for multi-planar unstable pelvic and complex acetabular fractures. Unstable pelvic and acetabular fractures usually resulted from high energy trauma, such as high-speed motor vehicular accidents, falls from height, and crush injuries [1]. Among the different mechanisms of unstable pelvic and acetabular fractures, the mechanism of falling from height always causes global instability of the pelvic ring or multiple levels of injury of the acetabulum, thereby resulting in treatment difficulty and unpredictable prognosis [2–4].

There is a high incidence of unstable pelvic and acetabular fractures in patients who fell from height [2,3]. Most patients may fall accidently; however, some fall from jumping intentionally. According to the literature, intentional fallers tend to have pre-existing mental disorders and easily fail to comply with medical orders because of their mood changes, psychological abnormalities, and history of drug abuse [5–8], contributing to their unpredictable prognosis after undergoing orthopedic procedures.

Previous studies majorly focused on the epidemiology, resuscitation outcomes, and quality of life assessments of patients with mental disorders who experienced pelvic fractures after attempting to commit suicide by jumping. However, the actual relationship between radiological outcome and functional prognosis of this specific group following these fractures and comparison of these outcomes between intentional and accidental fallers remain unknown. The current study was aimed to investigate the clinical outcomes of patients with unstable pelvic and acetabular fractures caused by intentional fall,

and to compare the clinical outcomes of these patients to those of accidental fallers who have similar injury mechanism and fracture patterns.

Methods

The current study retrospectively reviewed the patients with unstable pelvic and acetabular fractures who were admitted between 2014 and 2017. The inclusion criteria included patients with unstable pelvic and acetabular fractures due to fall from height who underwent osteosynthesis during the study period. Patients with unstable pelvic and acetabular fractures resulting from the etiologies other than fall injury, such as traffic accidents or crush injuries or those who underwent conservative treatment for any reason were excluded. Furtherly, the enrolled patients would be divided into 2 groups according to the etiology of fall: intentional fallers (I group) and accidental fallers (A group) for clinical parameters and outcomes comparisons. The review process of the patients' complete medical and imaging records was approved by the Institutional Review Board (IRB NO. 201900247B0).

As a tertiary referral trauma center, the patients were transferred to the emergency department either from the trauma scene or local hospitals. The resuscitation protocol was standardized and individualized, following the guideline from Acute Trauma Life Support and the resuscitative algorithm of pelvic fracture of the hospital. The injured patients were admitted to the regular wards or intensive care units after they were hemodynamically stabilized during the resuscitation stage. Osteosynthesis was performed once the patient's medical condition was optimized and suitable for anesthesia and operation.

The postoperative rehabilitation protocol was individualized according to the patient's medical condition or concomitant injuries. In general, toe-touch weight-bearing could be allowed 6 to 8 weeks after the index surgery and crutch- or walker-free ambulation could be started 6 weeks after toe-touch ambulation. Prophylaxis of venothromboembolism was routinely applied mechanically with compressions socks for 12 weeks but not pharmacochemically. There was no routine prophylactic practice for heterotrophic ossification following operations. For all the patients with intentional fall injuries, routine psychiatric consultations were done to confirm diagnosis, stabilize mental condition, and prevent occurrence of the next suicide attempts.

The current study adapted the classification of AO/OTA for pelvic fractures, Judtt-Letournal classification for acetabular fractures, and the classification of Denis and Roy-Camille for sacral fractures. Detailed records of out-patient-clinic follow-up were documented during their 12-month follow-up, at least. Functional outcome evaluations were conducted by using questionnaires of the modified Merle d'Albinague score and Majeed hip score at 6, and 12 months.

Statistical analysis was conducted using SPSS 18.0 (SPSS Inc., Chicago, IL, USA). Continuous variables are presented as the mean and standard deviation. We compared the preoperative and perioperative variables between the accidental and intentional fallers using the parametric t-test and nonparametric Mann-Whitney U-test. Categorical variables are reported as frequencies, and we compared the data of two groups using the parametric chi-square test. A two-tailed P-value of 0.05 was considered significant. In

addition, post hoc power analysis was performed with the G*Power software (version 3.1.9.4; Franz Paul, University Kiel, Germany) to determine the difference in trauma scores, early loss of follow up, early loss of fixation, and functional score evaluations between the two groups.

Results

During the study period, a total of 848 patients with fractures involving the pelvis and acetabulum were admitted to the emergency department of our hospital. The incidence of index fracture resulting from fall injury was 21.9% (186/848). Forty-nine patients (26.3%, 49/186) were treated surgically for their unstable fracture patterns. The complete demographic data of the 49 patients are presented in Table 1.

Among the enrolled patients, 16 were injured from intentional falls, including seven men and nine women with a mean age of 36.9 years (range: 18-92 years). All 16 patients had documented pre-existing mental disorders. The majority of the patients had adjustment disorders (n=9, 56.2%) as the pre-existing mental disorder, whereas the others were diagnosed with schizophrenia, substance abuse disorder, and mixed type mental disorders. Ten patients (81.2%) were diagnosed with pelvic ring and sacral injuries, whereas the remaining patients had complex fractures involving the pelvic ring, sacrum, and acetabulum. Four patients (25%) never returned to the out-patient-clinic department for follow-up evaluations after they received complete treatments and discharged from the hospital. For the remaining 12 patients who had regular follow-ups, three patients (25%) showed early loss of reduction or broken implants within 3 months after the osteosynthesis. However, none of them underwent revision surgery even though it was always highly recommended to the patients.

The comparison of the radiological and functional results between the patients whose injuries were caused by intentional falls (I group) or those whose injuries were caused accidental falls (A group) is presented in Table 2. The I group was significantly younger and had higher frequency of mental disorders, injury severity score (ISS), new injury severity score (NISS), abbreviated injury scale (AIS)-chest, and AIS-Abdomen; more severe fracture patterns; longer hospital stay; and higher incidence of early loss to routine follow-up (<3 months) than the A group.

Radiological outcome evaluations were performed by X-ray examinations during each clinical follow-up. Two patients in the I group who completed at least 3 months of follow-up showed a dislodge or broken implant (3/12, 25%). In the A group, three out of the 31 patients showed broken implants under the same assessment parameters (9.7%), but no significant difference ($p = 0.15$, chi square test) was found between the two groups.

Functional outcome evaluations were performed at 6 and 12 months after the index surgery. Overall, 30 patients (11 and nine patients in I and A groups, respectively) completed the functional outcome evaluations. At the 6-month follow-up evaluation, the I group showed lesser improvements in both the Merle d'Aubigne score (9 ± 4.5 vs 10 ± 3.7, $p=0.02$, Student's t test) and Majeed hip score (51.0 ± 17.8 vs 55.3 ± 17.2. $p=0.04$, Student's t test) than the A group. However, at the 12-month follow-up, no difference

in the Merle d'Aubigne score (11.9 ± 4.5 vs 13.4 ± 3.6, p=0.32, Student's t test) and Majeed score (68.3 ± 17.84 vs 72.6 ± 17.8. p=0.32, Student's t test) was found between the two groups.

Discussion

The present study aimed to compare the clinical parameters and outcomes between the intentional and accidental fallers with pelvic and acetabular fractures after osteosynthesis. The results revealed that all patients who fell intentionally had pre-existing mental disorders. Intentional fallers presented with younger age, higher ISS and NISS, longer ICU and hospital stay, and early loss to follow-up. However, the radiological and functional outcomes at the 12-month follow-up did not significantly differ between the intentional and accidental fallers.

Falls, regardless of the etiologies, cause great impact to the social-economic development. Accident fallers are usually at the working age; hence, they have contributions to their families and society [2]. Functional disability following a fall injury may impact their work productivity. On the other hand, intentional fallers, also called suicide jumpers, are a popular public health concern affecting low to advanced societies [8–16]. In Taiwan, suicide is the second leading cause of death among young people aged 15-24 years, the third among those aged 25-44 years, and the 12th in the general population [17]. Regardless of the reason of fall, all survivors in our case series fell from a height higher than 6 m and hit architectural ledges or fell onto hard-impact sites. Thus, they obtained higher ISS and NISS when compared to those patients in previous reports [2,8].

According to the literature, suicidal risk is 10 times higher in patients with psychiatric disorder than those without such disorders; at least one psychiatric disorder was reported between 60% and 98% of individuals who committed or attempted suicide [18–20]. The most common mental disorder found in people who committed suicide is depressive disorder (35%-80%), followed by schizophrenia (10%) and dementia or delirium (5%), which was in line with the result of our study [21]. Prevention of suicidal attempts is also a key point to reduce the morbidity and mortality from suicide. In our series, all intentional fallers were reported to have pre-existing mental disorders. A routine psychiatric consultation was performed for each faller with existing mental disorder in our series, and medication treatment and mental health consultation were conducted to prevent fall accidents from occurring again. Fortunately, more than half of the intentional fallers complied well to the medical orders; thus, there were no recidivisms during our follow-up period.

In general, post-osteosynthesis patients should strictly follow the medical advice and rehabilitation protocols in the early postoperative stage to prevent fixation failure, especially for those with unstable pelvic and acetabular fractures. The patients with mental disorders were thought to have poorer compliance to medical orders [2,22,23]. Before conducting this study, we expected that intentional fallers with pelvic and acetabular fractures would have a higher incidence of fixation failure compared to accidental fallers. Although 25% of the incidental fallers experienced fixation failure at the early stage, no significant difference was found between the I and A groups (p=015). This finding might indicate that a

secure fixation against the fractures was made for all of the patients, which allowed them to start with gait training as soon as possible. For the accident fallers, they were too eager to return to their activities of daily living as well as return to work so that they could earn and would not be laid out from their jobs. Therefore, we noticed a 13% loss of reduction and fixation in accidental fallers during our follow-up.

Several factors were associated with functional outcomes following orthopedic surgeries, such as the characteristic of fractures, quality of reduction and fixation, complications, rehabilitation protocol, patients' compliance, and so on [23–28]. During the study period, the principles, implants, surgical techniques, and physical therapies for treating pelvic and acetabular fractures were similar in all patients. Therefore, the influence of surgeons' and therapists' factors could be minimized. Our data revealed that the severity of injury and length of hospital and ICU stay were statistically higher and longer in the I group than in the A group. Moreover, the I group presented worse functional outcomes at the 6-month follow-up than the A group. However, at the 12-month follow-up, there was no difference in the functional outcomes between the two groups. During the interviews of all patients, we found that most of the intentional fallers were satisfied and thankful of the outcomes, whereas the accidental fallers had more complaints with their present situation and functional disability.

Although we made efforts to prevent any biases from occurring, there were still some limitations in the current study. First, we did a post hoc power analysis for the ISS, NISS, loss, early loss to follow-up, early loss of fixation, and functional score evaluations. At the significant level of 0.05 and a total sample size of 49, we obtained 93.2%-100% power to detect the difference in ISS, NISS, loss, early loss to follow-up, early loss of fixation, and 6-month functional score evaluations between the two groups. However, with a total sample size of 30 patients who completed 12-month follow-up, there was only 12% power to detect a 10% difference of the functional outcome. Important factors such as the relatively high percentage of lost patients (I group: 31.3%; A group: 42.4%) and patients' recall bias may underpower the ability to predict the difference. Nevertheless, the most important findings of our study were that the functional outcomes of the intentional fallers were comparable to those of the accidental fallers if the fractures were managed appropriately and that there was no recidivism during the follow-up period. Second, we classified the patients according to their self-report history. The true numbers of intentional fallers with mental disorders might be under-reported, thereby affecting the results of the analysis. A large sample size should be used in future studies, and these patients should undergo routine psychiatric examination to determine the true intentional fallers.

In conclusion, intentional fallers with pelvic and acetabular fractures might have worse clinical presentations than the accident fallers. Under a well-designed surgical protocol and individualized physical and mental rehabilitation program, the radiological and functional outcomes of the intentional fallers could be comparable to, or even better than, those of the accident fallers.

Abbreviations

AIS: abbreviated injury scale; NISS: new Injury Severity Score; ISS: Injury Severity Score

Declarations

Consent for publication

Not applicable

Ethics approval and consent to participate

1. The study protocol was approved by the Institutional Review Board (IRB NO. 201900247B0) of Chang Gung Memorial Hospital.
2. The consent obtained from study participants was written.

Availability of data and materials

All data generated or analysed during this study are included in this published article**.**

Competing interests

The authors declare that they have no competing interests

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Authors' contribution

Literature search: Hsu YH and Chou YC; Study design: Wei LC and Yu YH; Data collection: Yu YH; Data analysis and interpretation: Chen IJ and Yu YH; Writing: Yu YH; Critical revision: Yu YH.

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Tables

Table 1. Demographic distribution of 49 patients with pelvic and acetabular fractures who underwent osteosynthesis

All patients	49
Sex	
Male	35
Female	14
Age	43.5 ± 15.2
Injury mechanism	
Intentional	16
Accidental	33
Injury Severity Score (ISS)	16.6 ± 10.1
New Injury Severity Score (NISS)	19.8 ± 9.9
Fracture site and its classification	
Pelvis	31
61-B	16
61-C	15
Acetabulum	23
Involve 1 column	2
Involve 2 columns	17
Involve columns and walls	4
Sacrum	17
Dennis zone I	8
Dennis zone II	9
Roy-Camille type 1	2
Roy-Camille type 2	7
Roy-Camille type 3	1
Intensive care unit stay (days)	3.6 ± 5.4
Hospital stay (days)	21.2 ± 12.2
Follow-up (months)	15.5 ± 12.6

Table 2. Clinical comparison between intentional fallers and accidental fallers

	Intentional	Accidental	P value
Sex			
Male	7	28	
Female	6	5	
Age	36.9 ± 21.1	46.6 ± 10.6	0.04
ISS	21.9 ± 10.3	14.1 ± 9.2	0.01
NISS	24.3 ± 9.0	17.5 ± 9.7	0.02
AIS-Head	0.6 ± 1.3	0.5 ± 1.0	0.49
AIS-Face	0.3 ± 0.8	0.2 ± 0.5	0.71
AIS-Chest	2.4 ± 1.7	1.2 ± 1.6	0.02
AIS-Abdomen	1.7 ± 1.3	1.0 ± 1.2	0.049
AIS-Extremity	2.6 ± 0,7	2.5 ± 0.6	0.81
Mental disorder	16	0	0.00
Intensive care unit stay	4.6 ± 4.6	3.1 ± 5.7	0.37
Hospital stay	26.5 ± 12.6	18.6 ± 10.8	0.03
Follow-up duration	19.9 ± 15.0	13.7 ± 11.4	0.11
Follow-up <3 months	25% (4/16)	27.3 (9/33)	0.03
Loss of fixation (<3 months)	3/12=0.25	3/31=0.10	0.15
Functional follow-up			
Merle d'Aubigné Hip Score			
6 months	9.0 ± 4.5 (n=11)	10.0 ± 3.7 (n=19)	0.02
12 months	11.9 ± 4.5 (n=11)	13.4 ± 3.6 (n=19)	0.32
Majeed hip score			
6 months	51.0 ± 17.8 (n=11)	55.3 ± 17.2 (n=19)	0.04
12 months	68.3 ± 17.4 (n=11)	72.6 ± 17.8 (n=19)	0.32