Outcomes of operative treatment of acetabular fractures in Brunei Darussalam

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ABSTRACT

Introduction: Acetabular fractures are severe injuries, and the operative management is a challenge among orthopaedics trauma surgeons. There is no data available on long term follow up results as well as differences between the major acetabular fracture patterns in Brunei. **Materials and methods:** This is a retrospective study of 42 acetabular fractures treated surgically at RIPAS Hospital, Brunei Darussalam. Clinical and radiological measures were undertaken for measuring outcomes with a mean follow up of four years. **Results** The 42 cases consisted of 33 men, and 9 women with ages ranging from 13 to 60 years. All fractures were fixed with AO 3.5 mm lag screws, AO spring hook and AO 3.5 mm reconstruction plates through either posterior or ilioinguinal approaches. Congruent reduction was achieved in 41 hips (97.6%). Good or excellent functional results were achieved in 40 patients (95.2%). There was no case of infection. There were two cases of heterotopic ossification and three cases of grade II degenerative changes but none required arthrodesis or total hip replacement. Positive relationship was established between number of days before ambulation and total days spent in the hospital. Though the median duration of hospital stay was 26 days, transverse fractures spent 53.17 days in hospital. **Conclusion:** Early mobilisation is important to obtain favourable results. Functional results were comparable to other international studies and regional countries. Follow-up of four years is too short to predict the chances of development of degenerative changes in this study and therefore, these cases are still being monitored.

Keywords: Acetabular fracture, operative management, heterotopic ossification, congruency, functional results, Brunei

INTRODUCTION

Acetabular fractures are severe injuries, generally caused by high-energy trauma, most frequently from traffic accidents. [1] Operative management of acetabular fractures is a challenge among orthopaedics trauma surgeons. Advances in imaging technology have added more to our appreciation of the fracture patterns in these complex injuries [1, 2] and give more information to the original classification described by Letournel and Ju-

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In Brunei Darussalam there is rising incidence of Road traffic accidents casualties contributing to 5.95% of total deaths. [4] Though there is no mortality directly implicated with acetabular fractures in Brunei, a meta-analysis of published international literature has shown that the mortality rate associated with acetabular fractures is three percent. [5]

Information available about the acetabular fracture patterns in Brunei Darussalam have shown that early operation and early postoperative ambulation resulted in over all good prognosis for these major injuries. [6] However, there is no data available on long term follow up results as well as differences between the major acetabular fracture patterns.

The aim of this study was to analyse the patients with acetabular fractures who were operated in Brunei with emphasis on radiographic results, functional results and complications. A review of literature was done to obtain results of operative fixation of acetabulum from other centres including regional centres in South East Asia.

MATERIALS AND METHODS

This was a retrospective study. Study period was from the years 2005 to 2012. The total sample size was 54 patients. Inclusion criteria was patients with acetabular fractures who were treated by open reduction and internal fixation. It was possible to examine all the 54 patients at follow-up. Exclusion criteria were associated head, chest, abdominal or other injuries requiring prolonged hospital stay. As a result 12 patients were excluded from the study.

Table 1: Classification of fractures with number of patients.

	Letournel and Judet classification [4]	No. of patients
Simple pattern	Posterior wall (Type A)	13
	Transverse fracture (Type E)	6
	Posterior Column with Posterior wall (Type F)	1
	Transverse with Posterior Wall (Type G)	4
Complex pattern	T-Type (Type H)	11
	Anterior Column with posterior hemi-transverse (Type I)	1
	Both Column (Type J)	6

The follow up protocol in the study hospital included clinical and radiographic examinations to be performed at six months, one year, and two years. Thereafter detailed clinical examination and radiographs were performed only if patient had any problems.

For the purpose of this study all the 42 patients included in the study were called back to the clinic for radiographic and clinical assessment. Case records, plain radiographs and computerised tomography films of the cases were analysed. The fractures were classified and tabulated according to the classification described by Letournel and Judet (Table 1). [3]

Indications for open reduction and internal fixation were; 1) displacement of the fragments more than two mm in the dome of the acetabulum; 2) incarcerated intra-articular fragments; 3) posterior or central dislocation or subluxation of femoral head; 4) roof arc measurements of less than 45 degrees; 5) posterior wall fractures with more than 50% involvement of the articular surface

of the posterior wall; and 6) clinical instability with hip flexion.

In the majority of cases, definitive surgery was carried out within 10 days after medical stabilisation of the patients and adequate planning with pre-operative imaging studies. The chief surgeon in all cases was a single senior experienced surgeon. Posterior approach (Kocher-Langenbeck) was used in 40 cases with the patient in the prone position and Ilioinguinal approach in the cases. [7-10] All acetabular fractures were fixed with AO spring hook and AO 3.5 mm reconstruction plates.

Partial weight bearing was started at six weeks and full weight bearing at three months. Indomethacin was started on the 3rd post-operative day as prophylaxis against heterotopic calcification and continued for two months. All patients received antibiotic prophylaxis for five days and low molecular weight heparin, Daltaparin for thromboprophylaxis.

Outcome measures: Follow-up clinical examinations were done for an average of four years (range 1-8 years). Radiographic follow-up was done by assessing Antero Posterior pelvic view and 45 degree oblique Judet views. Residual displacement of 2mm or less was considered as congruent. For assessing signs of degenerative changes Kellgren and Lawrence grading was used. [11] Functional result was evaluated by Harris grading. [12] Brooker's classification was used to grade heterotopic ossification. [13]

Statistics: For statistical analysis, correlational analysis was carried out based on bivariate relationship among the variables. One-way analysis of variance (ANOVA) was used to explore for differences among the types of fractures.

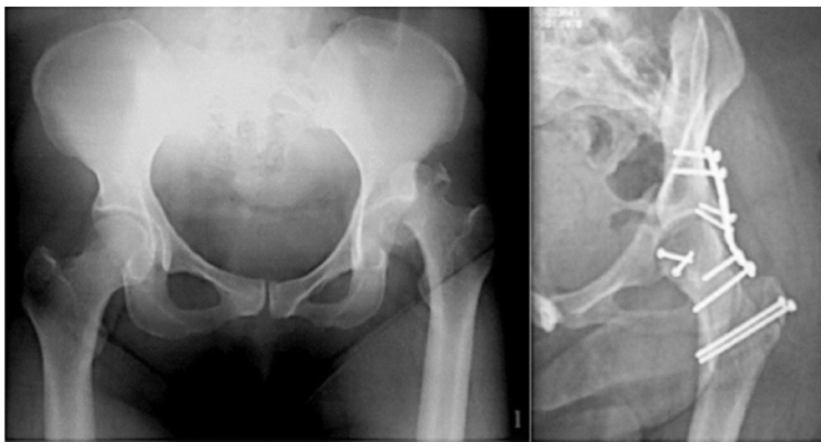
RESULTS

The total sample size was 54 patients. Twelve patients with associated head, chest and abdominal injuries were excluded leaving 42 cases for the study. Out of these 42 cases, 33 were men, and nine were women. Their age range was 13 to 60 years, with a mean age of 35 years.

The right hip was affected in 25 cases and the left in 17. Forty injuries resulted from high energy traffic accidents and two from falls from heights. Associated injuries included sciatic injuries (n=9), fracture long bones of the extremities (n=6), and posterior dislocation of head of femur (n=5). Based on the Letournel and Judet classification, majority of the cases were fractures of the Posterior wall (n=13) followed by T-type fractures (n=11). (Table I).

Post operatively, congruency was achieved in 41 cases (97.6 %) (Figure 1). In one case, the transverse fracture reduction was short of anatomical reduction by 3mm. This did not affect the comminuted posterior wall fractures which were reduced anatomically and held in position with AO spring hook plates. The area of displacement was not a weight-bearing area, and this was accepted.

One patient required evacuation of haematoma anterior to the gluteus maximus at day five post-operation and the wound eventually healed without any sequelae. There was delayed wound healing in a young obese lady. On follow up, no patient had radiologi-



Figs. 1: Fractured left acetabulum pre and post-operative radiographs demonstrating congruent reduction.

cally evident avascular necrosis. However, there were Grade II osteoarthritis (n=3) and Grade II heterotopic ossification (n=2). Twenty-nine patients achieved excellent functional results by Harris grading with 11 having good results (included the two patients with radiographic evidence of Grade II OA and the two cases of Grade II Brooker's classification heterotopic ossification). Despite these changes, it did not affect their hip function. There was one patient with radiographic Grade II osteoarthritis who had a score of fair. The other patient who had a score of fair had a residual foot drop.

Overall, 83.3% of patients with transverse fractures and both column fractures had excellent functional result by Harris grading (Table 2). The three cases of Grade II radiologic osteoarthritic changes are being closed followed up. If their situation becomes progressive they may be candidates for total hip replacement in the near future.

Seven patients in this series had preoperative sciatic nerve damage as a result of the primary injury. They all had exploration of the sciatic nerve during their operative fixation surgery. The operative findings in these patients were that of a grossly intact sciatic nerve, but stretched in continuity by dislocated head of femur, or displaced fragments of the posterior wall. There was no need to carry out any nerve repair on any of the patients in this series. All of these patients have finally recovered at the last follow up, except for one patient who had to wear anti-foot drop orthosis for residual peroneal palsy.

Table 2: Fracture pattern and functional results.

Fracture pattern	Number of cases	Functional results (n and %)		
		Excellent	***Good***	***Fair***
Type A	13	8 (61.5)	5 (38.5)	0 (0)
Type E	6	5 (83.3)	1 (16.7)	0 (0)
Type F	1	0 (0)	0 (0)	1 (100)
Type G	4	2 (50)	2 (50)	0 (0)
Type H	11	8 (72.7)	3 (27.3)	0 (0)
Type I	1	0 (0)	1 (100)	0 (0)
Type J	6	5 (83.3)	0 (0)	1 (16.7)

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Correlational analysis showed significant positive relationship was established between number of days before ambulation and total days spent in the hospital (r=0.89; $p<0.001$, n=42). Relationships between operational delay and total days spent in the hospital showed very weak correlation which was not significant (r=0.01; $p>0.05$, n=42).

Comparison between Fracture Posterior Wall (FPW) (n=4) and Transverse Fractures (TF) (n=6) showed that patients with TF had longer days before surgery, before mobilisation and the overall longer hospital stay. These differences were significant for days before mobilisation and total days in hospital. (Table 3).

Comparison between with complex or associated fractures (Fracture Posterior Column and Posterior Wall, n=4, Transverse and Posterior Fractures, n=1 and Both Column Fractures, n=6) showed no statistically significant difference among the three types of fractures in the three parameters (Table 4).

Looking at the influence of age, younger patients (<20 years old) spent longer days in all three variables, significant for days before ambulation and the total number of days in hospital (Table 5). Teenagers had more multiple and complex fractures than

Table 3: Comparison of Fracture Posterior wall (FPW) and Transverse fractures (TF).

Variables	Groups	N	Mean (SD)	t	df	*p*
Days before surgery	FPW TF	13 6	10.8 (9.2) 12.5 (12.7)	-0.34	17	0.739
Days before ambulation	FPW TF	13 6	13.2 (9.9) 28.6 (21.6)	-3.01	17	0.008
Total days in hospital	FPW TF	13 6	22.8 (12.9) 53.2 (30.8)	-3.09	17	0.007

Table 4: ANOVA summary testing differences among Complex fracture groups.

Variables	Source	df	SS	MS	F	*p*
Days before surgery	Between groups Within Groups Total	2 18 20	2171.66 17101.58 19273.24	1085.83 950.09	1.14	1.14
Days before ambulation	Between groups Within Groups Total	2 18 20	965.35 5549.89 6515.24	482.68 308.33	1.57	0.24
Total days in hospital	Between groups Within Groups Total	2 18 20	1222.23 5303.48 6525.81	611.17 294.64	2.07	0.16

Table 5: Comparison of those aged less than 20 years and above 20 years.

Variables	Groupa	N	Mean (SD)	t	df	*p*
Days before surgery	<20 yrs. ≥20 yrs.	5 37	15.4 (13.1) 13.5 (23.9)	0.17	40	0.317
Days before ambulation	<20 yrs. ≥20 yrs.	5 37	46.2 (18.7) 18.9 (17.8)	3.20	40	0.030
Total days in hospital	<20 yrs. ≥20 yrs.	5 37	53.6 (19.3) 29.9 (19.7)	2.75	40	0.009

Table 6: Comparisons between males and females.

Variables	Groups	N	Mean (SD)	t	df	sig
Days before surgery	Males Females	33 9	14.9 (25.5) 9.4 (5.7)	0.63	40	0.533
Days before ambulation	Males Females	33 9	23.0 (18.2) 19.3 (24.5)	0.49	40	0.628
Total days in hospital	Males Females	33 9	32.0 (20.5) 27.0 (24.4)	0.62	40	0.536

adults and these results may not be surprising. There were no differences between males and females on any of the operational variables (Table 6).

DISCUSSION

Fracture of the posterior wall is the most common pattern in literature. [3] This current series also confirmed this. The clinical outcome after posterior-wall fractures can be poor despite anatomical reduction. [19]

The vast majority of our cases were done using the posterior Kocher-Langenbeck approach. The advantage of this approach is that it involves minimal muscle dissection and therefore blood loss is also minimal. The disadvantages are that the exposure is close to the superior gluteal neurovascular bundle, sciatic nerve and the medial femoral circumflex arteries.

The timing of acetabular surgeries depends on stabilisation of any other associated injuries, obtaining all detailed imaging modalities for preoperative planning and the availability of an experienced surgeon. Exceptions to this are in cases associated with dislocations as well as open fractures associated with vascular injuries. Studies have shown that an average delay of 11 days can still give an acceptable reduction. [20] But beyond two weeks, reduction becomes more difficult due to the callus formation, organised haematoma and granulation tissue. In this current series, the mean duration spent before surgery was 10 days. These results match those of other regional centres in South East Asia. [18, 21]

Immediate functional analysis at the perioperative period showed significant correlation between the number of days spent before mobilisation and the total number of days spent in the hospital. Generally, the earlier the patients are operated and mobilised, the earlier they get discharged. Analysis of our patients showed that within the simple (elementary) group of fractures, transverse fracture types spent significantly more days in the hospital than posterior wall fractures. There were no significant differences between days spent in the hospital within the various patterns of the complex/associated group. The median duration of stay in hospital in this series was 26 days. This again compares well with other regional centres. [18] The finding of a longer hospital stay among teenagers in this study as compared to adults is explained by the fact that most of the injuries in teenagers are high velocity injuries, with resulting multisystemic injuries.

Based on the findings of our study, 95.2 % of the patients had good to excellent functional results, which are very favourable compared to published results from other centres including regional centres in South East Asia (Table 7). [14-18] This could be due to the

Table 7: Comparison of published results from other centres

Authors	Cases	Mean follow up (yrs.)	Excellent/ good results (%)
Briffa *et al* [14]	161	11.3	73
Matta *et al* [15]	255	6	76
Mayo [16]	163	3.7	75
Ruesch *et al* [17]	53	1	83
Tan *et al* [18]	15	1.9	80
Current study	42	4	92.5

fact that all the surgeries were done by a single senior experienced surgeon. But the cohorts in this database are small, and the period of follow-up still too early to form any firm opinion. Hence this as an interim report and the patients are still being followed up, watching out for onset of disabling degenerative changes that may benefit from total hip arthroplasty.

In our series there were no cases of symptomatic deep vein thrombosis or pulmonary embolism. All the patients were placed on low molecular weight heparin (Daltaparin), 5000 IU subcutaneously as prophylaxis. This was continued post-operatively for at least two weeks or until patients were fully ambulant.

The overall incidence of osteoarthritis following operatively treated acetabular fractures has been reported to be 26.6%. [22] Patients with post traumatic arthritis and disabling pain may require total hip arthroplasty or arthrodesis. This trend cannot be confirmed in this limited study in which there were three cases of Grade II osteoarthritis. Femoral head avascular necrosis must be apparent within the first 18 months of surgery. Letournel and Judet reported a 3.8% incidence of femoral head avascular necrosis. [3] In this series, there were no cases of femoral head AVN on last follow up.

Heterotopic ossification (Brooker I-IV) is known to occur in 25.6% cases of acetabular fractures with 5.7% third and fourth grades. [13, 23, 24] The expected rate of functionally disabling heterotopic ossification for the various surgical approaches is, 8% for Kocher -Langenbeck, 20% for extended iliofemoral and 2% for ilioinguinal. [3] There were only two cases (4.8%) in this series with no major disabling heterotopic ossification. Studies have shown that Indomethacin is effective in prevention of heterotopic ossification. [25] All the patients in the current series had received Indomethacin for prophylaxis.

Meta-analysis of acetabular fractures have shown an overall incidence of post-traumatic nerve palsies of 16.4% and rising to more than 40% in fractures associated with posterior dislocation of the hip. [22] The incidence of iatrogenic nerve palsy was around 8%. In 25% of the cases, the palsy had been already present before the surgery, but a faulty neurological exam, in the preoperative period had failed to identify it. [3] In the current series, seven patients had pre-operative sciatic nerve damage which amounted to 16.7% of the cases, and none required nerve repair. This was in agreement with the above meta-analysis.

There was one complication of superficial surgical wound infection in an obese young lady of BMI 37 (kg/m^2). The wound eventually healed at around four weeks. An earlier published study has shown that wound infections are more common in the obese patients. [26]

The limitation of this study is that preexisting comorbidities have not been analysed to look into the impact they would have had on the outcome in these patients. Also, not all the patients underwent post-operative computed tomography (CT) scan to assess congruity. One of the recommendations of this study is that all patients must in the future be assessed independently by CT scan.

In conclusion, based on this study finding and other international literature, experience of surgeon and early mobilisation of patients are important in obtaining good results. The duration of stay in hospital and functional results were comparable to other international studies and other countries in the region. Transverse fractures spent more days in hospital compared to the other fracture patterns. Patients are still being closely followed up to detect any long term complications such as osteoarthritis.

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