

External fixation-assisted reduction for the treatment of neglected hip dislocations with limb discrepancy: a retrospective study of 13 cases.

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Abstract

Abstract Background: The purpose of this study is to evaluate a new method for treating obsolete acetabular dislocation with limb discrepancy by external fixation assisted pre-reduction. **Methods:** Thirteen patients admitted from January 2010 to February 2018 with a mean duration from injury to surgery of 5.0 ± 2.1 months and an average preoperative leg-length discrepancy of 7.7 ± 2.3 cm were enrolled in this study. The dislocation and associated acetabular fracture type, clinical outcomes and residual limb equality were evaluated. **Results:** All patients were posterior dislocations and nine presented with acetabular fractures and were followed-up at least 12 months. The average traction duration of external fixators was 28.8 ± 8.0 days and all patients received second-stage open reduction and internal fixation. Six patients showed residual limb discrepancy within 2 cm. Patients showed significant improvement in hip function and pain relief. Complications including avascular femoral head necrosis and osteoarthritis occurred in 3 patients. **Conclusion:** Effective correction of limb discrepancy and improved function showed in patients with obsolete acetabular dislocations and limb equality using traction by external fixation combined with second-stage open reduction. The long-term outcomes need continued follow-up.

Background

Traumatic hip dislocation is usually caused by high-energy trauma and accounts for 5% of all traumatic joint dislocations [1]. Most dislocations are caused by motor vehicle accidents and associated with unfastened safety belt [2]. Early recognition and a prompt reduction is of great importance [3, 4] because delayed diagnosis may lead to long-term complications including avascular necrosis of the femoral head (AVN) and osteoarthritis [5]. Neglected hip dislocations are rarer in adults, especially in high-income countries [6]. However, in developing countries, patients stop seeking medical help or visit the hospital many days after trauma because of financial strain and neglected hip dislocations are not uncommon [7]. But the modern literature is limited on this subject.

Common clinical manifestations of neglected hip dislocation are shortening of the limb and limited function of hip joint. For patients with neglected fracture, callus formation and adhesion caused by connective tissue make regular reduction difficult. The common treatments reported in previous studies for neglected hip dislocation included skeletal traction and open reduction, but usually ended with unsatisfactory outcome and are associated with high incidence of post-operative complications such as nerve injury, AVN, and osteoarthritis [8, 9]. Garrett et al. recommended total hip replacement (THR) for hip dislocations with a duration of >3 months [10], but others have reported that limited correction of limb discrepancy that could be accomplished by THR [11, 12]. Considering that the best treatment for neglected hip dislocation remains controversial and to improve clinical outcome, we propose a new surgical strategy to treat neglected acetabular dislocations using external fixators in preoperative traction. The aim of this study was to discuss the feasibility of this operation method.

Patients And Methods

We reviewed all patients with neglected hip dislocation treated in our department from January 2010 to February 2018 and identified twenty patients. Inclusion criteria were: (1) neglected hip dislocation of which duration from trauma to surgery was more than 3 weeks, (2) treated with external fixators, (3) 18 < age < 60. Seven patients were excluded because that they were treated by skeletal traction or other surgery. In total, thirteen patients were enrolled in this study. Permission for this retrospective study was obtained from the Medical Ethics Committee of authors' institution, and written informed consent was obtained from every patient. All patients suffered posterior dislocation and the classification has been described by Thompson and Epstein [13]. The associated acetabular fracture has been classified by Judet-Letournel [14]. The function of the hip joint was evaluated using the modified Merle D'Aubigné and Postel scoring system [15], and clinical outcome was graded as follow: excellent (18), good (15–17), fair (13–14), and poor (<14). Residual pain was assessed according to the visual analogue scale (VAS). Leg length was measured from the umbilicus to the medial malleolus by clinical examination. Statistical testing was performed with the unpaired t-test, and the level of significant difference was defined as $P < 0.05$.

Surgical procedures

All surgeries were performed by a single experienced orthopedic surgeon. First-stage traction by external fixation: surgeries were performed on patients under regional anesthesia. Two incisions of approximately 1 cm were made on the iliac crest and lateral thigh. Two screws were placed in the anterior inferior iliac spine, and another two screws were placed in the femur mid-diaphysis under fluoroscopic guidance. A monolateral external fixator was then connected (Fig 1). The traction procedure began 3 days after surgery, with the external fixator stretching 1–3 mm a day. A plain X-ray radiogram was taken every 5–7 days to examine the reduction. Traction stopped when the femoral head was drawn beneath the articular surface of the acetabulum.

Second-stage open reduction: after the first-stage traction, open reduction was operated under general anesthesia. A Kocher-Langenbeck (K-L) approach or combined approaches of ilioinguinal and K-L were used. After superficial and deep dissection, a trochanteric flip osteotomy was performed when the acetabular roof fracture was present to allow for adequate exposure of the hip capsule. Capsulotomy was then performed, followed by clearing of fibrous tissue and intra-articular fragments, and finally a reduction of the femoral head. The malunion of posterior acetabular wall was then reconstructed and fixed with cannulated screws and a 3.5 mm reconstruction plate. An autogenous iliac bone graft was used when needed. The osteotomized trochanter was fixed with 2–3 small fragment cortex screws. A postoperative skeletal traction was used according to the condition of open reduction.

Results

Thirteen patients (five women, eight men) with an average age of 36.7 ± 10.5 years (range, 19–49 years) were enrolled in this study. Nine patients were associated with acetabular fractures, and the pattern of fracture and posterior dislocation are shown in Table 1. The mean duration from injury to surgery was

5.0±2.1 months (range, 2.5–9 months). The mean preoperative leg-length discrepancy was 7.7±2.3 cm (range, 5–12.2 cm). Six patients presented with a postoperative leg-length discrepancy within 2 cm (Table 2). The average traction duration of external fixators was 28.8±8.0 days (range, 17–46 days). The mean operation time was 2.7±0.8 hours, and the average blood loss during the surgery was 1067.4±374.5 mL. All patients were followed up for at least 12 months, with a mean follow-up duration of 15.4±5 months (range, 12–18 months). The mean Merle d'Aubigné score improved significantly from 5.1±1.7 to 14.4±2.0 after surgery ($p<0.01$). The mean preoperative VAS score was 4.3±1.3, and the mean postoperative score was 0.9±1.0 ($p<0.01$), with five patients completely free of pain. No neurovascular injuries related to stretching occurred in these patients. Complications occurred in three patients during the follow-up, two patients had AVN, and one patient had osteoarthritis of the hip joint. None of the patients received further treatment at the last follow-up.

Discussion

Neglected hip dislocations often occur in children and are rarely reported in adults. This study showed effective correction of limb discrepancy and significant function improvement with external fixation-assisted reduction in consecutive thirteen adult patients. Though skeletal traction is important in joint reduction, the acetabulum becomes filled with fibrous tissue in neglected dislocations would make reduction difficult by simple traction. Skin traction usually carries a weight under 5 kg. Halo-femoral and tibial tubercle traction can carry more weight but it often ends with unsatisfactory results in patients with neglected hip dislocation [9, 16]. Prolonged dislocation may cause severe joint contracture so it is difficult to achieve satisfied reduction by regular traction. Furthermore, heavy traction may lead to a high risk of neurovascular complications.

Distraction osteogenesis by external fixators has been widely used in patients with bone defects [17]. The good extension and regeneration ability of the skin and bones offers a theoretical basis for the application of external fixators in traction reduction. Screws were placed in the anterior inferior iliac spine and ipsilateral femur mid-diaphysis to assemble the external fixator. The daily lengthening was about 1–3 mm and could be suitably increased according to the patients' tolerance. Plain radiographs were routinely taken to examine the correction of the shortening. Though shortening could be effectively corrected through traction by external fixators, it was hard to achieve accurate reduction and the associated acetabular fracture, which occurred in 10 patients who also needed surgical repair. Open reduction was performed when the femoral head was reduced underneath the articular surface. At this time, with muscle stiffness alleviated, the surgery was accomplished with minimal invasiveness and duration.

Intermittent traction by an external fixator was accomplished with a moderate force, and was more tolerable in patients compared with heavy weight traction. The external fixators made patients cast off long-stays in bed, and no complications related to prolonged immobilization such as pressure sores or venous thrombogenesis were observed. Neurovascular condition was closely monitored during the

traction. Stretching would be suspended if neurological signs such as paralysis and pain occurred and continue after symptoms relief. No neurovascular injuries related to stretching occurred in our patients.

Common complications of traumatic hip dislocation include infection, sciatic nerve palsy, AVN, heterotopic ossification, and posttraumatic arthritis [18]. Previous studies have reported that the incidence rate of arthritis was 16.1–30.0%, and 8.1–10% for AVN in the mid-to-long-term follow-up [1, 19]. The blood supply to femoral head is often damaged by traumatic dislocation, especially the medial femoral circumflex artery. Vascular compromise leads to intravascular coagulation and ischemic necrosis, resulting in chondral failure and accelerated joint degeneration [20]. A high incidence of osteonecrosis has been reported from 10–25% in hip dislocations [21]. Furthermore, the severity of the injury and time to reduction are associated with increased risks of osteonecrosis.[20] The rate of osteonecrosis is only 10% in adults after simple dislocation, but reaches 70% if the dislocation is accompanied by severe proximate bony destruction such as fracture of the femoral head and acetabulum [22]. Hougaard and Thomsen reported that the rate of osteonecrosis of the femoral head can be reduced from 58% to 4.8% if hip reduction is performed within the first 6 h following injury [23]. Others have concluded a trend for decreased osteonecrosis of the femoral head when hip reduction was performed within 12 h [1]. In our patients, AVN occurred in 2 patients (15.4%), and osteoarthritis occurred in 1 patient (7.7%). All 3 patients suffered acetabular fractures with an average duration from injury to surgery of 6.3 months (range, 4 to 8 months). We agree with previous studies and think the long duration and associated injury could be critical factors. Patient 6 (Table 1) showed AVN 10 months after the surgery, and the Merle d'Aubigne score was improved from 4 to 12. Patient 7 (Table 1) showed AVN 12 months after surgery, and the Merle d'Aubigne score was improved from 5 to 13. Patient 11 (Table 1) showed osteoarthritis at the last follow-up (14 months), and the score was improved from 4 to 11. Though complications occurred, patients acquired significant function improvement. Scholars have also reported that complications usually developed within 5 years of dislocation [7, 24], though our study only reports a short-term follow-up result within 18 months. As the incidence of secondary complications may increase with time[25], an accurate complication rate should be recalculated for long-term follow-up.

THR has been recommended for hip dislocations with a duration of more than 3 months [10], but usually providing limited correction of limb discrepancy within 6 cm [11, 12] and muscle release was needed for better correction [26]. It may provide limited efficacy for patients in this case series which all suffered limb inequality of more than 5 cm. Considering all patients were under 50 years and no signs of necrosis or arthritis occurred when on admission, we decided to perform open reduction and fixation after traction. Follow-up results showed significant pain relief and function improvement. The satisfactory rate of clinical outcome was 53.8% (excellent and good results). Limb discrepancy was effectively corrected, and no patient was left with >2 cm of inequality, thereby laying the foundation for possible THR in the future. AVN and arthritis occurred in three patients. Though they showed unsatisfactory outcomes (two poor and one fair), none of them received further treatment at the last follow-up. The clinical efficacy of the open reduction and THR should be compared in a more convincing case control study, and a more accurate assessment of complications should be concluded with long-term follow-ups.

From our experiences, external fixation was effective for pre-reduction in patients suffering from neglected acetabular fractures with limb discrepancy, but still several contraindications are noteworthy. First, it should not be used in patients with heterotopic ossification, which most commonly occurs in the hip joint, and the incidence after traumatic dislocation was 32% to 37% [27, 28], because traction would be resisted by ectopic bone. As the fixation technique requires stable anchors, it is unfit for patients with an unstable pelvic ring or femur. Furthermore, patients with osteoporosis should not be considered because osteopenic bone may fail under power of traction.

There are limitations in this study including the retrospective design and a small number of patients. This study only reported short-term results and did not compare with other operation strategy. Long-term clinical outcome should be followed and a larger number of patients should be included in the future to evaluate clinical value of our method.

Conclusions

From our experiences, the equality of lower limb could be effectively corrected and promising outcome could be acquired during short-term follow-up by external fixator assisted pre-reduction in patients with neglected acetabular dislocations and limb discrepancy,. It is simplicity of operator with good compliance for allowing for considerable motion. We provide a new usage of external fixation and a more convincing evaluation of its clinical efficacy would be done in the long-term follow-up.

Abbreviations

AVN: avascular necrosis of the femoral head, VAS: visual analogue scale, K-L: Kocher-Langenbeck, THR: Total hip replacement

Declarations

Acknowledgments

No

Authors' contributions

PL and DQ drafted the manuscript. WS helped collected clinical materials. JD and DZ revised the manuscript. All the authors have read and approved the final manuscript.

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Availability of data and materials

The data used in the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study was approved by The Medical Ethical Committee of Shandong Provincial Hospital Affiliated to Shandong University. The informed consent was obtained from all patients included in this study

Consent for publication

Not applicable.

Competing interests

The authors declare no conflict of interest.

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Tables

Table 1. Patients' detail

Patient	Duration from trauma to surgery(months)	Acetabular fracture type	Posterior dislocation type	Follow-up (months)	Clinical outcome	VAS	Complication
1	5	No	I	15	Good	1	
2	4.5	No	I	13	Good	0	
3	9	No	I	18	Fair	1	
4	5.5	No	I	14	Good	0	
5	3	Posterior wall	I	15	Excellent	0	
6	8	Posterior wall	II	17	Poor	2	AVN
7	4	Transverse with posterior wall	II	17	Fair	3	AVN
8	3	posterior wall	II	15	Good	0	
9	2.5	Posterior column with posterior wall	III	18	Poor	2	
10	2	Posterior wall	III	15	Good	0	
11	7	Posterior wall	III	14	Poor	1	OA
12	5	Transverse with posterior wall	IV	13	Good	1	
13	6	Posterior column with posterior wall	IV	16	Fair	1	

AVN: Avascular femoral head necrosis

OA: Osteoarthritis

Table 2. Correction of limb discrepancy

Patient	Inequality of lower limb(cm)		Traction duration(days)
	preoperative	postoperative	
1	5.6	0	17
2	5.4	0	21
3	8.2	1	27
4	5	0	25
5	7.5	0	25
6	8.8	1.5	34
7	12.2	2	46
8	6.0	0	27
9	9.4	2	35
10	5.3	0	20
11	11	1	38
12	7	1.5	31
13	8.2	0	28

Figures

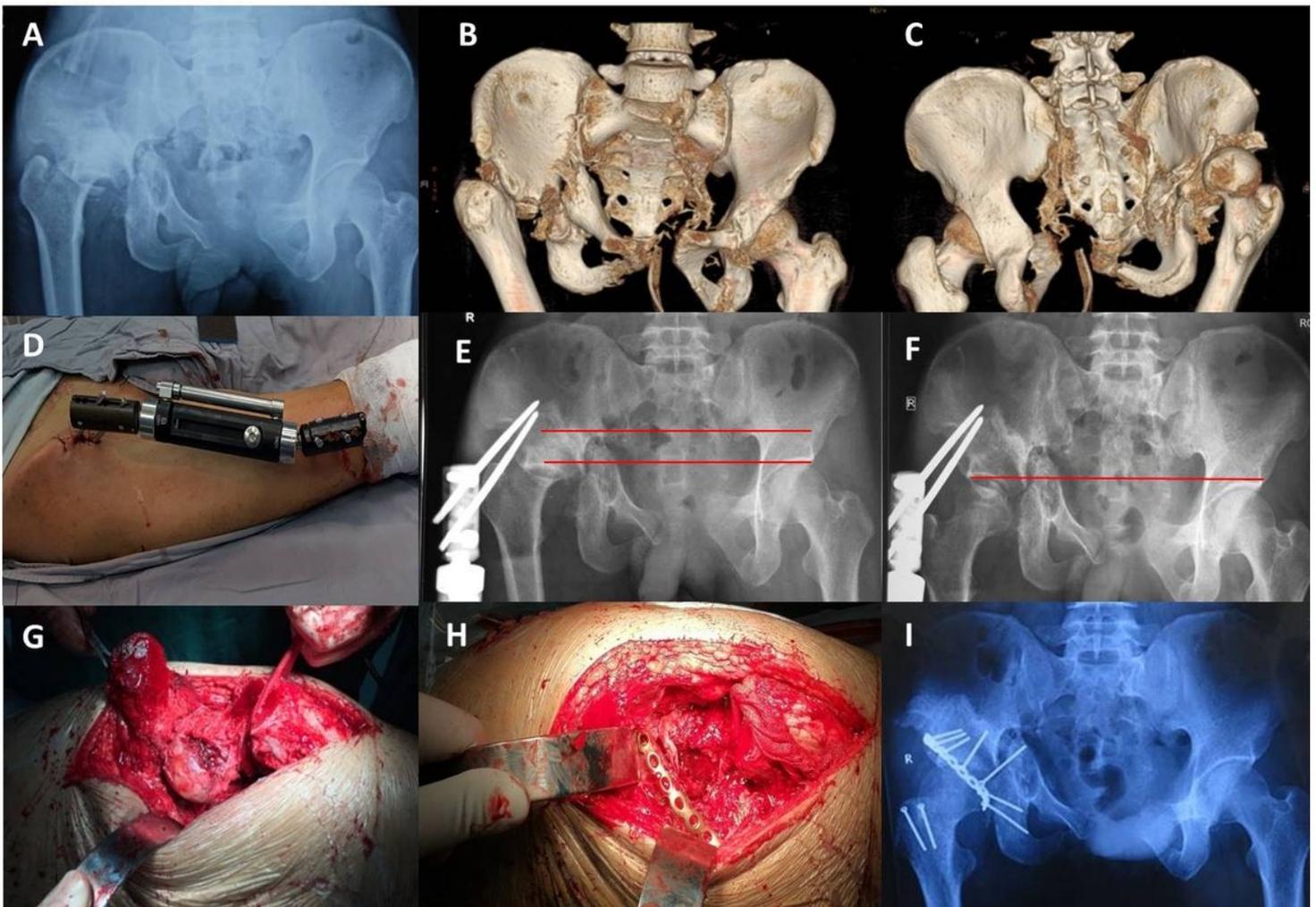


Figure 1

Patient 12. (A)-(C) Preoperative X-ray and three-dimensional reconstruction computed tomography images 6 months after injury. (D)-(E) External fixation placement. (F) The femoral head was drawn

underneath the articular surface after 31 days of traction. (G)-(H) K-L incision, open reduction with osteotomy of the greater trochanter, and fixation of posterior wall of acetabulum. (I) Postoperative X-ray image showed correction of limb discrepancy and reduction of femoral head. Part of Figure 1 was originated from our previous study[29] and was authorized by Chinese Journal of Orthopaedic Trauma.