

External fixation assisted reduction in the treatment for obsolete hip dislocations with limb discrepancy

Pengyu Li

Shandong Provincial Hospital Affiliated to Shandong University

Wenhao Song

Shandong Provincial Hospital Affiliated to Shandong University

Jinlei Dong

Shandong Provincial Hospital Affiliated to Shandong University

Daodi Qiu (✉ qiudaodifly@163.com)

Shandong Provincial Hospital Affiliated to Shandong University

Dongsheng Zhou

Shandong Provincial Hospital Affiliated to Shandong University

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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 were 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] Common clinical manifestations of obsolete hip dislocation are shortening of the limb and limited function of hip joint. For patients with obsolete fracture, callus formation and adhesion caused by connective tissue make regular reduction difficult. The common treatments reported in previous studies for obsolete hip dislocation included skeletal traction and total hip arthroplasty.^[6, 7] Here we propose a new surgical strategy to obsolete acetabular dislocations by using external fixators in preoperative traction. The aim of this study is to discuss the feasibility of this operation method.

Patients And Methods

We reviewed all patients with old hip dislocation treated with external fixators in our department from January 2010 to February 2018 and 13 patients were enrolled in this study. Permission for this 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 was described by Thompson and Epstein.^[8] The associated acetabular fracture was classified by Judet-Letournel.^[9] The function of hip joint was evaluated using modified Merle D'Aubigné and Postel^[10] scoring system. Residual pain was assessed according to visual analogue scale (VAS).

Surgical procedures

First-stage traction by external fixation: surgeries were performed on patients under regional anesthesia. Two incisions about 1cm were made on the iliac crest and lateral thigh. Two screws were placed in anterior inferior iliac spine and another two screws were placed in femur mid-diaphysis under fluoroscopic guidance. Then a monolateral external fixator was connected.(Fig 1) The traction procedure began 3 days after the surgery with external fixator stretching 1 to 3 mm a day. Plain X-ray radiogram was taken every 5 to 7 days to examine the reduction. Traction stopped when 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 the incision of articular capsule, exposed hip joint space, cleared fibrous tissue and intra-articular fragments, reconstructed and fixed acetabulum, then reducted femoral head.

Postoperative skeletal traction was used according to condition of open reduction.

Results

Thirteen patients were enrolled in this study with 5 female patients and 8 male patients. The average age was 36.7 ± 10.5 years (range, 19-49 years). 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 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 average blood loss during the surgery was 1067.4±374.5 ml. All patients were followed up at least 12 months with a mean 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 the 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 5 patients completely free of pain. Complications occurred in 3 patients during follow-up, 2 patients had AVN and one patient had osteoarthritis of hip joint. None of them received further treatment at the last follow-up.

Discussion

Neglected traumatic hip dislocations are rare in adults. High-energy trauma are often associated with multiple injuries including abdominal organs and lower limbs.[11] The urgent of maintaining hemodynamic stability and to handle combines injuries may cause delayed diagnosis and treatment of fracture and lead to obsolete hip dislocation. Also some patients stopped seeking medical help or attended hospital many days after trauma because of financial strain, especially in developing countries. [11] Skeletal traction is important in joint reduction. The common used traction techniques for hip joint

include skin, halo-femoral and tibial tubercle traction. It usually takes two to three weeks for skin traction with a traction weight under 5kg otherwise complications like skin break or vesicles may occur. Though halo-femoral and tibial tubercle traction can carry more weight but often end with unsatisfied results in patients with neglected hip dislocation. Pai and Kumar[12] reported heavy traction and abduction conducted for eight patients with neglected posterior dislocation and only four of them achieved concentric reduction. Gupta[6] used traction of seven to eighteen kilograms for five to seventeen days which allowed over-reduction of the dislocation and then gradually reduced the femoral head into the acetabulum by reducing the traction and abduction but failed to reduct dislocation with a duration for more than two months. For patients who had neglected hip dislocation, prolonged dislocation may cause severe joint contracture. It's difficult to achieve satisfied reduction by regular traction. Also heavy traction may lead high risk of neurovascular complications.

Distraction osteogenesis by external fixators has been widely used in patients with bone defects.[13] The good extension and regeneration ability of skin and bone offers theoretical basis of the application of external fixators in traction reduction. Screws were placed in anterior inferior iliac spine and ipsilateral femur mid-diaphysis to assemble the external fixator. The daily lengthening was about 1 to 3mm and could be suitably increased according to patients' tolerance. Plain radiograph was routinely taken regularly to examine the correction of 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 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 and the surgery was done with less invasiveness and reduced duration.

Intermittent traction by external fixator was done with moderated 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 like **pressure sores** or venous **thrombogenesis**. Neurovascular condition was closely monitored during the traction. Stretching would be suspended if neurological signs like 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, avascular femoral head necrosis (AVN), heterotopic ossification and posttraumatic arthritis.[14] Previous studies reported the incidence rate of arthritis was 16.1% to 30.0% and 8.1% to 10% of AVN in the mid-to-long-term follow-up. [1, 15] In our patients, AVN occurred in 2 patients (15.4%) and osteoarthritis occurred in 1 patient (7.7%). Scholars also reported that complications usually developed within 5 years of dislocation [11, 16], our study only reports a short-term follow-up result within 18 months. As the incidence of secondary complications may increase with time[17], the accurate complication rate should be recalculated in the long-term follow-up.

Chronic unreduced hip dislocations are often associated with acetabular fractures which make reduction difficult and carry high risk of postoperative complication rate. And however, sometimes even after open

reduction and internal fixation, the hip may secondarily dislocate because of the unachieved stability.[7] Total hip replacement (THR) was recommended for hip dislocations with duration more than 3 months[18] but usually providing limited correction of limb discrepancy within 6cm[7, 19] and muscle release was needed for better correction.[20] THR 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 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 more than 2 cm inequality laying the foundation for possible THR in the future. Though AVN and arthritis occurred in 3 patients, none of them received further treatment at the last follow-up. The clinical efficacy of two methods should be compared in a more convincing case control study and a long-term follow-up.

From our experiences, external fixation was effective for pre-reduction in patients suffered old acetabular fractures with limb discrepancy, but still several contraindications are noteworthy. First, it shouldn't be used in patients with heterotopic ossification, which most commonly occurs in hip joint and the incidence after traumatic dislocation was 32% to 37%, [21, 22] for traction would be resisted by ectopic bone. As the fixation technique need stable anchors, it is unfit for patients with unstable pelvic ring or femur. Also osteoporosis patients shouldn't be under consideration for 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 didn't compare with other operation strategy. Long-term clinical outcome should be followed and a larger sample size with randomized-controlled design study should be done 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 obsolete 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 is 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

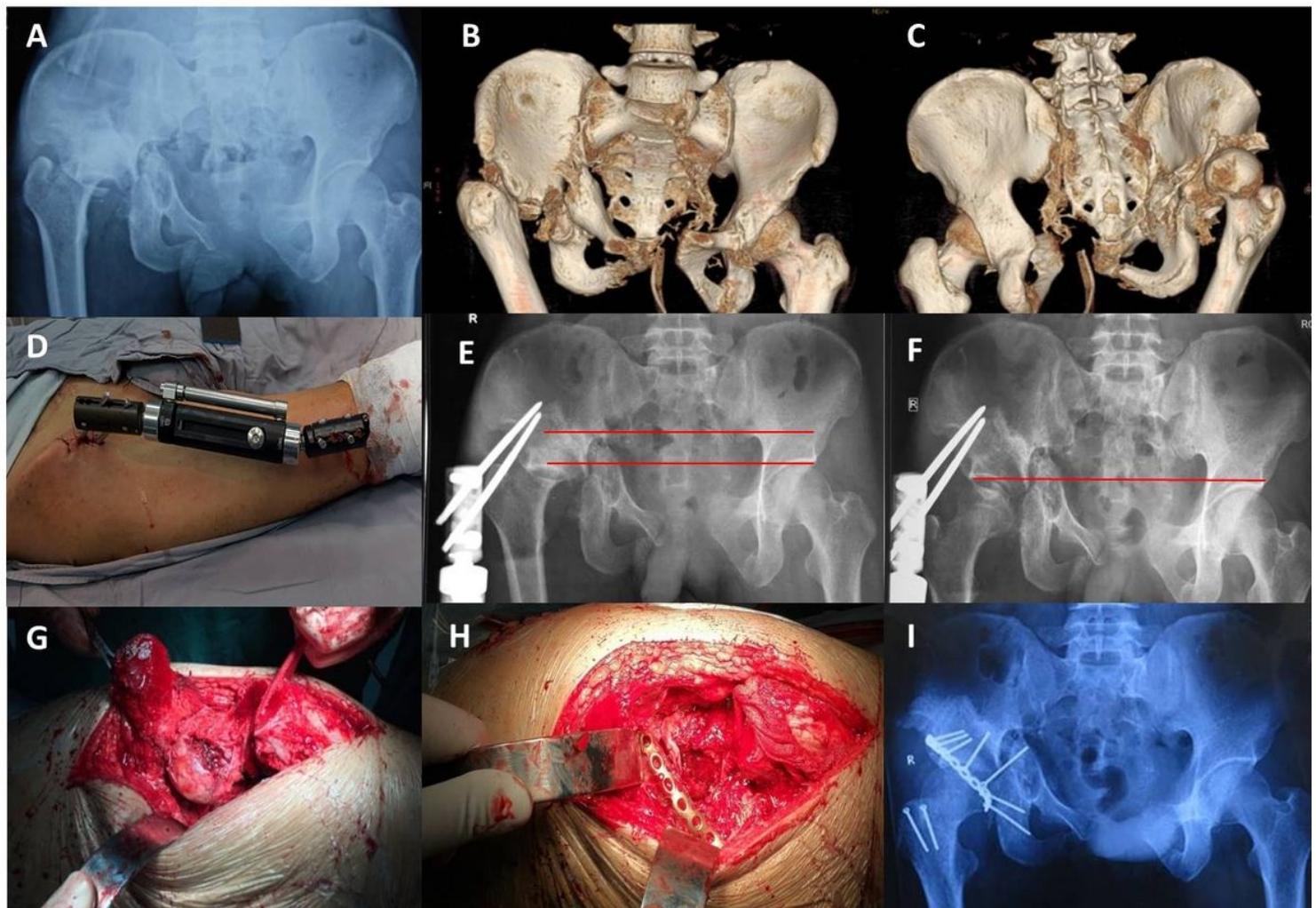


Figure 1

Patient 12. (A)-(C) Preoperative X-ray and Three-dimensional reconstruction CT image, 6 months after injury. (D)-(E) External fixation placement. (F) 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[23] and was authorized by Chinese Journal of Orthopaedic Trauma.