A Prospective Study of Management of Fracture Dislocation of Hip (PIPKIN) by Safe Surgical Dislocation (2 Years 6 Months Follow-Up in a Tertiary Hospital at Visakhapatnam)

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ABSTRACT

BACKGROUND

High velocity motor vehicle injuries are associated with hip fracture dislocations especially dash board injuries. Most commonly posterior hip dislocations are associated with occasional femoral head fractures. Computerized tomographic imaging is done to look at the congruency of the hip joint. Safe surgical dislocation or Ganz approach was described in 2001 for exposing the hip in a 360-degree view without damaging the vascularity of the femoral head. In this study, we wanted to evaluate the radiological and functional outcome using modified Merle d' Aubigne-Postel and Harris hip scoring.

METHODS

The current study is a prospective study in a tertiary referral centre where 8 young adult males were followed up for a period of 2 years 6 months from August 2018 to February 2021 after safe surgical dislocation and reduction with headless Herbert screws to maintain congruent hip surface.

RESULTS

We had 1 patient with associated chest injury requiring intercostal tube placement, while none of them had developed avascular necrosis or early arthritis. We had used modified Merle d'Aubigne-Postel and Harris hip scoring to assess the functional outcome. We had six patients with excellent results and two patients with good outcome due to occasional pain. We followed all the patients for more than 2 years. We evaluated the radiological and functional outcomes. The results are comparable to other researcher's studies.

CONCLUSIONS

Safe surgical dislocation is a very good choice for fixation of femoral head fractures where the complications like early arthritis of femoral head and acetabulum are less along with preserving the vascularity of the femoral head and preventing the chances of avascular necrosis of femoral head. It also provides a good intra-operative view for handling the fracture reduction.

KEYWORDS

Pipkin Fracture, Ganz Approach, Safe Surgical Dislocation Hip, Herbert Screw

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BACKGROUND

Femoral head fractures were first described by Birkett in 1869 during an autopsy.[1] Garett Pipkin from Kansas City in 1957 had further classified femoral head fractures based on 25 patients attributable to motor vehicle accidents and had been credited with classification of femoral head fracture dislocation.[2]

Femoral head fractures have been classified by Pipkin into 4 types. Type 1 is hip dislocation with femoral head fracture distal to fovea capitis femoralis. Type 2 is hip dislocation with femoral head fracture proximal to fovea capitis femoralis. Type 3 is a Type 1 or 2 fracture with associated femoral neck. Type 4 is a Type 1 or 2 fracture with associated acetabular rim fracture.[2] These high velocity motor vehicle injuries are associated with poor functional outcome and have been known to cause post-traumatic early arthritis and avascular necrosis of hip.[3] It is well established by multiple studies that early reduction and stable & congruent fixation are associated with good functional and radiological outcomes to minimize potential complications.[4] Ganz. et al. in 2001 had described safe surgical dislocation of hip without jeopardizing the vascularity of femoral head but gaining complete access to femoral head for fixation.[5]

Before the description of Ganz procedure, surgeons used either a posterior southern-moore approach or anterior approach to expose the hip joint where the vascularity of the femoral head was jeopardized, with the understanding of the blood supply of the femoral neck and the need to preserve the retinacular vessels and the modification in the incision of the femoral capsule by a Z-shaped incision without disturbing the posterior capsule. The femoral head and neck fracture management has become better by avoiding osteonecrosis.

Objectives

1. To look for the development of early arthritic changes in femoral head & acetabulum as well as changes of avascular necrosis after a successful surgery for reducing and stabilizing femoral head with headless cannulated Herbert screws and fixation of trochanter by Ganz surgical approach
2. To evaluate the radiological outcome and functional outcome by using Modified Merle d'Aubigne-Postel score and Harris Hip score at 6 months interval.
3. To evaluate the results of safe surgical dislocation of hip for fixing femoral head fractures in a tertiary referral centre

METHODS

It is a prospective study done in a tertiary referral center from August 2018 to February 2021 for a period of 2 years and 6 months on 8 patients. All the patients were males and aged between 25 to 45 years. All of them have been referred beyond 24 hours from the time of injury after initial non-concentric reduction of hip. We received all our patients from remote areas ranging from primary health care centres to district hospitals from our neighbouring districts and state where an initial closed reduction was attempted. We proceeded to do safe surgical dislocation after getting our computerized tomographic images (Figure 1). We had patients with fractured incongruent femoral heads, flipped femoral heads, loose fragments obstructing the reduction.

Inclusion Criteria

Our study is a single centre study wherein we followed convenience sampling method and had included all the 8 patients whom we had been referred for surgical management.

Exclusion Criteria

We had excluded children below the age of 18 years.

Surgical Procedure

After obtaining the written informed consent where we had explained about the complications of the surgical procedure and after homeo-stabilisation of the patient, we proceeded for Ganz or safe hip dislocation under spinal epidural. We had planned for acetabular wall reduction also in our pre-operative planning in two of the patients with acetabular rim fractures. The patients were positioned in lateral position with the affected hip joint up and we performed a Kocher-Langenbeck incision through skin and subcutaneous tissue exposing Fascia-Lata. Fascia-lata is incised and gluteus maximus is split along the fibres exposing the trochanteric bursa. The trochanteric bursa is teased off exposing the short external rotators using a diathermy. Pyriformis, gemelli and obturator internus and externus are identified and a mark is made using electrocautery for the intended trochanteric osteotomy extending from postero superior border of greater trochanter distally to the posterior border of vastus lateralis ridge. The deep branch of medial circumflex femoral artery is preserved by the intact obturator externus muscle preserving the blood supply of femoral head. Osteotomy is made along the marked site and the capsule is incised in a z-shaped manner, with the first limb of the incision along the anterolateral axis of the femoral neck. The second limb of the incision is made starting at the anterior border of the piriformis tendon and coursing antero-inferior. This incision remains anterior to the lesser trochanter to avoid the main branch of medial circumflex femoral artery.[5] A curved knife is used in an inside-out manner to create the final limb by incising posteriorly from the first incision, parallel to the labrum and the acetabular rim. In conclusion, the hip is dislocated anteriorly using a posterior surgical approach and trochanteric osteotomy (Figure 2). In short, our aim is to preserve the femoral head and neck vascularity without damaging the retinacular vessels as well as the main branch of medial circumflex vessels with due care taken to expose the femoral head and neck as well as the acetabulum. The hip is exposed using a modification of the posterior incision but dislocating the head anteriorly. The femoral head is dislocated from the

acetabular socket by anterior dislocation with the affected limb manipulated by the assistant by keeping the limb in a figure of 4 position.

Once the fracture fragments are exposed, the rotations and orientation of fragments are rechecked and held with thin K-Wire, the congruency of femoral head is checked under image intensifier as well as clinically as we have a 360-degree view of both femoral head and acetabulum. Thorough wash is given to remove any debris or loose cartilaginous flakes. The fracture fragments are fixed with headless cannulated Herbert screws (Figure 3). Thorough wash is given once again after fixation also and the hip is reduced and movements are checked intra-operatively. We check the terminal flexion and extension movements as well as stability. The trochanter is fixed with two 4.5 mm cortical screws. Final stabilization checked using image intensifier. Surgical wound is closed in layers with 1 vicryl. Fascia lata is sutured in continuous suture and gluteus maximus in interrupted sutures. Subcutaneous area sutured with inverted sutures using 1 - 0 vicryls and skin staples are applied. Post-operatively, the patients are kept in surgical intensive care unit (ICU). We mobilized all of them with non-weight bearing as early as from 24 hours to 72 hours depending on pain using walker support. We encourage in bed physio while in the hospital. Rehabilitation protocol included non-weight bearing mobilization till 6 weeks using two crutches and partial weight bearing for the next 6 weeks using single crutch on the unaffected side and conversion of usage of crutch to the same side when pain subsided.

RESULTS

All the patients in our current study were males. There were 8 subjects and we had 6 patients with fracture on right side of hip and 2 on left.

PIPKIN Type	Number of Patients
Type 1	3
Type 2	3
Type 3	0
Type 4	2

Table 1. Different Types of PIPKIN Fractures in Our Study

Associated Injuries	No. of Patients	Progress
Sciatic nerve injury	1	Recovered in the post-operative period
Ipsilateral haemothorax	1	Intercostal tube inserted and recovered

Table 2. Associated Injuries

We had no Type 3 fractures in our series. We had one patient with pre-existing sciatic nerve injury for which we did nerve exploration and found the nerve to be intact which recovered in the post-operative period. One patient had chest injury and had to undergo intercostals tube placement on the ipsilateral side for haemothorax. This patient had an intensive care unit stay for a longer period under the ICU team for the care of ICT drain and for the lung injury.

We followed modified Merle d'Aubigne-Postel and Harris hip scoring as enclosed in Table 3 for functional evaluation of outcome starting from 6 months and evaluated every half yearly.

Domain		Score
Pain	No pain	6
	Slight or intermittent	5
	Pain after ambulation, but it disappears	4
	Moderately severe, permits ambulation	3
	Severe with ambulation	2
	Severe, prevents ambulation	1
Ambulation	Normal	6
	No cane, but slight limp	5
	Long distances with cane or crutch	4
	Limited, even with support	3
	Very limited	2
	Bedridden	1
Range of movement (%)	95 – 100	6
	80 – 94	5
	60 – 79	4
	40 – 59	3
	0 – 39	1

Table 3. Modified Merle d'Aubigne-Postel Score and Harris Hip Score Modified Merle d'Aubigne-Postel Score (Possible Values: 3–18)

		Criteria	Score
Pain		None or ignores it	44
		Slight, occasional, no compromise in activities	40
		Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take aspirin	30
		Moderate pain, tolerable but makes concessions to pain. Some limitation of ordinary activity or work. May require occasional pain medicine stronger than Aspirin	20
		Marked pain, serious limitations of activities	10
		Marked pain, serious limitations of activities	0
A. Gait	1. Limp	None	11
		Slight	8
		Moderate	5
		Severe	0
	2. Support	None	11
		Cane for long walks	7
		Cane most of the time	5
		One crutch	3
		Two canes	2
		Two crutches	0
		Unable to walk	0
B. Activities	1.Stairs	Normally without using any railing	4
		Normally using a railing	2
		In any manner	1
		Unable to use stairs	0
	2. Shoes and socks	With ease	4
		With difficulty	2
		Unable	0
	3. Sitting	On ordinary chair for at least 1 hour	5
		On a high chair for one-half hour	3
		Unable to sit comfortably in any chair	0
	4. Distance	Unlimited	11
		Six blocks	8
		Two or three blocks	5
		Indoors only	2
		Bed and chair	0
Absence of deformity		5.- Able to enter public transportation	1
		4 points are given if the patient demonstrates:	4
		a. Less than 30° fixed flexion contracture	
		b. Less than 10° fixed adduction	
		c. Less than 10° fixed internal rotation in extension	
		d. Limb-length discrepancy less than 3.2 cm else, the patient receives 0 points	
Range of movement (ROM)		Index values are determined by multiplying the degrees of motion by the indices. The ROM score is given by adding the index values multiplying with the factor 0.05, Maximum score gives 5 points	5
		a. Flexion: 0 – 45° * 1.0, 45 – 90° * 0.6, 90 -110° * 0.3	
		b. Abduction: 0 – 15° * 0.8, 15 – 20° * 0.3, > 20° *0	
		c. External rotation in extension: 0–15° * 0.4, >15° * 0	
		d. Internal rotation in extension: any * 0	
		e. Adduction: 0 – 15° * 0.2	

Table 4. Harris Hip Score

The overall numeric score is given by adding the domain scores. Clinical grades for the Harris hip score:
Excellent 90 – 100, Good 80 – 89, Fair 70 – 79, Poor < 70.

We had enclosed below the details of all of our study by modified Merle d'Aubigne-Postel score and Harris hip score at second year after surgery in table 4.

Score	No. of Patients
Excellent	6
Good	2
Fair	0
Poor	0

Table 5. Our Functional Results Using Modified Merle d' Aubigne-Postel Score and Harris Hip Score

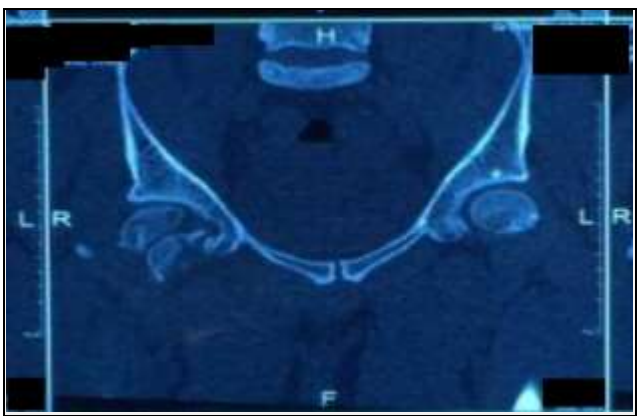

Figure 1. (CT Image of Fractured Femoral Head Where the Fractured Head Turned 180°) Needing Surgical Intervention

Figure 2. Hip Dislocated Anteriorly by Ganz Approach and Fractured Head Identified after Trochanteric Osteotomy

Figure 3. Post-Operative X-Ray with Reduced Femoral Head and Congruent Hip Joint after Stable Fixation with Headless Cannulated Screws (Herbert Screws) and Trochanter Stabilised with Cortical Screws

We evaluated our patients in our hospital till 14 days of surgery. After discharge, we followed all of our patients at 6 weeks, 3 months, 6 months, and for every 6 months. None of them were lost for follow-up. At each visit biannually, we evaluated radiological outcome with x-rays of pelvis with both hips for any signs of secondary arthritis, collapse of femoral head, avascular necrosis, or heterotopic ossification. We also checked the functional outcome using modified Merle d'Aubigne-Postel score and Harris hip score every 6 months. Out of eight patients, only two had occasional pain and limp requiring on and off usage of NSAIDs, remaining six patients had excellent results with no pain, limp or decreased movements of hip joint.

Statistical Data

We had excellent functional outcome in 75 % of our patients and good functional outcome in 25 % of our study population. We had no patient with fair or poor outcome in our study. We followed the modified Merle d'Aubigne-Postel score and Harris hip scoring system. With regards to radiological outcome, we hadn't come across femoral head collapse, femoral head necrosis, heterotopic ossification, loss of congruency of hip joint in our study population.

DISCUSSION

None of the patients developed avascular necrosis or heterotopic ossification in our series. We had followed our patients at 6 weeks, 3 months, 6 months and biannually with serial x-rays to assess the radiological outcome and also for clinical examination to see the outcome. Though the hips were reduced outside and referred to us, the safe surgical dislocation and reduction had no cases of avascular necrosis in our study which is a significant one. We are still following them for signs of early arthritis. We hadn't used any indomethacin or prophylactic radiation for prevention of heterotopic ossification. We also hadn't used bisphosphonates in the post-operative period in any of our study population. We relied on NSAIDs and combination of tramadol and paracetamol for post-operative pain control. Mobilisation in the post-operative period was done with the help of two elbow crutches and non-weight bearing on the affected limb till 6 weeks. After six weeks, we allowed them to walk with single elbow crutch for two weeks on the unaffected side and then changed to the affected side for partial weight bearing. All of them were made to walk full weight bearing by 3rd month follow-up. From 3rd month all of them were mobilized without any walking aid although we suggested them the use of walking aid in case of any uncontrollable pain or difficulty in standing or in situations needing more physical activity. All of them by six months follow-up were comfortable walking unaided except for two patients who needed tramadol and paracetamol combination for control of pain. By the end of even 1 year, both of the patients needed occasional analgesics.

The current study assessed the radiological and functional outcome on a relatively small sample size of population with a significant high velocity motor vehicle accident causing hip fracture dislocation after safe surgical dislocation without interrupting the femoral neck and head vascularity by Ganz approach. We also followed them up closely and at regular intervals to observe the role of absolute rigid fixation of femoral heads using multiple cannulated head less screws to provide stability as well as any chances of osteonecrosis by radiological imaging. While the functional outcome was assessed by modified Merle

d'Aubigne-Postel score and Harris hip score and occasional pain in two of the eight patients were managed by NSAIDS, tramadol and paracetamol combination. We hadn't encountered any Pipkin type 3 though their occurrence is rare and their outcome is not as promising as the remaining 1, 2 or type 4 variant of Pipkin. The positive factors for good to excellent outcome include early and timely intervention to reduce the hip joint, evaluation of the reduction with computerised tomography (CT), proper pre-operative planning including acetabular fracture stabilization, meticulous soft tissue handling, knowledge of vascularity of hip, preserving the short external rotators and circumflex vessels and retinacular arteries, trochanteric osteotomy, z-shaped capsular incision, haemodynamic stabilization, multimodal support from specialists to deal with polytrauma, early guarded rehabilitation and progressively improving the range of movements, regular follow-up and documentation of outcome and comparison with peers and reviewing the literature.

CONCLUSIONS

Though safe surgical dislocation is technically challenging, its results are highly encouraging providing a 360-degree view of both acetabulum and femoral head as well as providing a stable fixation to maintain congruency of joint without damaging the vascularity. Knowledge of vascular supply of the femoral head and neck plays a vital role in the outcome. The role of headless screws in the femoral head and sinking them beyond the cartilage probably might play a role in preventing early arthritis. Major complications like heterotopic ossification, avascular necrosis and posttraumatic arthritis can strongly affect long-term results for these patients[6]. It is not clearly defined if heterotopic ossification relates with the surgical approach,[7,8] and despite some authors recommending systematic use of indomethacin as prophylaxis, there are no clear guidelines to its prevention.[4] Several factors have been associated with the development of heterotopic ossification like polytrauma, male sex, associated acetabular fractures, mechanical ventilation, delay to surgery, and femoral head injuries.[9] We had not seen cases with ectopic ossification in our series. When comparing functional outcomes, recent literature showed consistently satisfactory functional results in patients with femoral head fixation through Ganz approach, a safe and optimal choice.[10,11] We can even use this approach to excise the intracapsular osteochondromas of the neck of femur without jeopardizing the vascularity and improving the movement by removing the bony obstruction by the protruding hamartomous growth. Our drawbacks include a relatively small series, single surgeon, single centre and a shorter follow-up which we might be able to overcome in the long run. We didn't have any cases with Pipkin type 3 in our study which were rare and are known for poor prognosis. This absence of rare variant of pipkin 3 and the small sample size were limiting factors in our study. To conclude, safe dislocation as a procedure is helpful for the hip surgeons to provide a good to excellent functional outcome. The important steps for managing these fractures include a strong intensive care back-up including round the clock ICU teams, other multimodal team members to tackle associated injuries, anaesthetist, thorough knowledge of femoral head and neck vascularity, experience in Ganz approach, Post-operative rehabilitation with particular attention to analgesics and guarded physiotherapy and regular follow-up protocols.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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