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Ganz Surgical Dislocation of the Hip Is a Safe Technique for Operative Treatment of Pipkin Fractures. Results of a Prospective Trial

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Objectives: The primary objective was to study the incidence of femoral head osteonecrosis after Ganz approach for Pipkin fracture dislocations. Clinico-radiological and functional outcomes were also studied.

Design: Prospective, nonrandomised.

Setting: Tertiary care trauma center.

Patients: Twenty-eight patients with type I/II Pipkin fracture dislocation reduced within 6 hours of injury.

Intervention: The displaced head fracture was addressed through safe surgical dislocation after urgent closed reduction of the hip.

Outcome Measurements: Incidence of osteonecrosis using radiographs and functional outcome using modified Merle d'Aubigne and Oxford scores were studied.

Results: Twenty-six fractures were fixed, and 2 type I fractures were excised. Twenty-six of 28 patients were followed up for a mean of 36 months. There was no osteonecrosis. All fractures and osteotomies had united. The mean modified Merle d'Aubigne score was 16.5 (14–18), and the mean Oxford score was 42.65 (38–48).

Conclusions: Safe surgical dislocation provides satisfactory results in Pipkin fracture dislocations. The incidence of osteonecrosis is not increased in patients undergoing early joint reduction.

Key Words: femoral head fracture, hip dislocation, pipkin, surgical dislocation, Ganz

Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

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AU3 The authors report no conflict of interest.

The study may be attributed to the department of trauma and orthopaedics, Parvathy hospital, Chennai.

The institutional review board (Parvathy hospital) approved the study.

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INTRODUCTION

Traumatic hip dislocations in adults represent high-energy injuries. Most of the dislocations are posterior and can be associated with fractures of the acetabulum, femoral head and neck. The incidence of associated femoral head fractures is reported to be approximately 7%¹ in a posterior hip dislocation. The hip needs to be urgently reduced to restore blood supply to the femoral head.² Displaced isolated head fractures (Pipkin I and II injuries) with incongruent reductions need open surgery. There may be a high incidence of posterior labral avulsions, and repair of these injuries may improve long-term outcome. Internal fixation or excision of the head fragments can be performed depending on location and size to establish congruency and to prevent arthritis. Anterior approach for internal fixation is preferred and can be performed either using the Smith Peterson approach or the safe surgical dislocation described by Ganz et al.³ Safe surgical dislocation theoretically preserves the vascular supply to the femoral head and provides a circumferential exposure for internal fixation. The use of the approach for femoral head fracture fixation however has not been studied in any prospective trials. The surgical approach involves a posterior exposure with a trochanteric slide osteotomy, anterior capsulotomy followed by dislocation of the joint anteriorly. We have been using the Ganz approach to operate incongruent hips with displaced femoral head fractures at our institution from 2009. We report our results with the approach in 28 Pipkin fractures with a minimum follow-up of 2 years.

PATIENTS AND METHODS

The institutional review board approved the study, and informed consent was obtained from all patients. There were a total of 36 femoral head fractures during the study period. Twenty-eight patients who underwent internal fixation/fragment excision of type I/II Pipkin fractures after initial closed reduction of the hip within 6 hours of injury were included in the study. The chief outcome measurement was to study the occurrence of osteonecrosis of the femoral head using the safe surgical dislocation, so patients with delayed hip reductions and other Pipkin type injuries were excluded.

All patients had an emergency closed reduction in the operating room after an initial anterior–posterior x-ray of the pelvis. Hips that were incongruent and unstable after reduction were placed in traction. Postreduction computed tomography scan dictated further treatment. All hips with incongruent

reductions were operated on early. Supra and infrafoveolar displaced head fragments big enough to allow fixation were internally fixed. The surgical approach was performed as described by Ganz et al.⁸ Capsular avulsions from the femur extending to the anterosuperior portions are common in these injuries, and it may not allow a typical capsulotomy and repair of the capsule as described by Ganz et al. Anterosuperior capsular avulsions should be considered, and the capsulotomy modified as necessary to get access to the femoral head. Repair of the capsular avulsions can be performed by drill holes in to the proximal femur (Fig. 1). The ligamentum teres if still attached was removed, and all debris from the joint was cleared. Small osteochondral fragments and free cartilage flaps were removed. Fixation was done with 2.4-mm headless screws (Synthes—India). Associated labral tears if present were repaired with 3-mm suture anchors (Smith & Nephew—India). The osteotomy was fixed with three 3.5-mm cortical screws.

Patients were allowed toe touch weight-bearing for 8 weeks followed by full weight-bearing. Immediate hip range of motion exercises was initiated. Thromboembolic prophylaxis with low-molecular-weight heparin was administered for 2 weeks.

Radiographic assessments were performed at 6 and 12 weeks during follow-up visits. Further radiographic examination was performed at every 6 months thereafter until final follow-up in asymptomatic patients. Functional assessment was performed using the modified Merle d'Aubigne scores and Oxford hip scores at last follow-up.

Statistical Analysis

The influence of labral injuries, fracture location, comminution, and osteochondral defects on the modified Merle d'Aubigne scores was evaluated using independent *t* tests. The influence of the above parameters in the occurrence of degenerative arthritis was assessed using Fisher exact tests. Logistic regression analysis was used to study the influence of surgical timing on the occurrence of degenerative arthritis and functional scores. The level of significance was set at $P < 0.05$.

RESULTS

Twenty-six of 28 patients were available for follow-up. Two patients had migrated and could not be located. The mean follow-up was 36 months (25–46 months). According to Pipkin classification, there were 22 type II fractures and 6 type I fractures. Twenty-six patients underwent fixation, and 2 patients with a type I fracture underwent fragment excision. The mean time for surgery was 9.5 hours (2–26 hours) after the attempted closed reduction. After reduction, hip was found concentric and stable in 9 patients.

The fracture was found comminuted (>1 fractured fragment) in 9 patients. Associated injuries in the ipsilateral limb were present in 13 patients. Fracture of the femoral shaft was the most common association seen in 9 (32%) patients. Other injuries include proximal tibia fractures in 2 patients, distal femur fractures in 2 patients, and lateral femoral avulsions were seen in 2 patients.

All fractures were internally fixed, and osteotomies had united without further intervention. No instance of

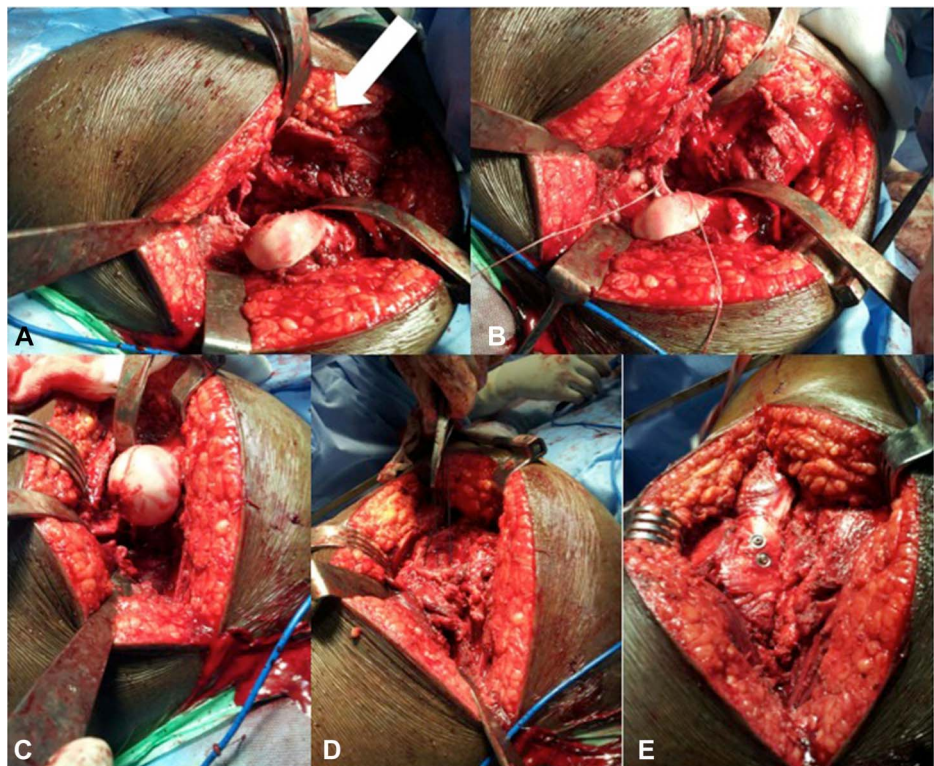


FIGURE 1. A Pipkin type II fracture operated through the Ganz approach. A, The osteotomized trochanter fragment is reflected anteriorly (block arrow). B, C, Posteroinferior labral injury fixed with suture anchors and fracture fixed anatomically using headless screws. D, Anterosuperior capsular avulsion secured using drill holes into the trochanter and (E) osteotomy fixed with 3.5-mm screws.

osteonecrosis was evident on follow-up radiographs. All fractures demonstrated anatomical reduction without any step

AU4 **correct** ively and on postoperative radiographs (Fig. 2).

F2 Areas of denuded cartilage and gaps in chondral surface in the weight-bearing portion of the head were evident intraoperatively in 6 patients. Posttraumatic arthritis was seen in 3

F3 **correct** (1.5%) at follow-up period. Heterotopic ossification (grade I—2 and grade II—3) was seen in 5 patients (Fig. 3). Early deep infection was seen in 1 patient and was treated satisfactorily with debridement and prolonged course of antibiotics. Painful trochanteric bursitis seen in 1 patient was relieved after removing the screws.

Statistical analysis showed significantly increased risk for arthritic changes in patients with comminuted fractures ($P = 0.03$) and residual chondral defects ($P = 0.008$) in the weight-bearing area after surgery. Presence of labral injury did not increase the occurrence of degenerative arthritis ($P = 0.14$).

The mean modified Merle d'Aubigne score was 16.53 (range: 14–18). The outcome was classified as excellent in 9, good in 15, and fair in 2 patients. The mean Oxford hip score was 42.65 (range: 38–48). The modified Merle d'Aubigne scores were significantly low in patients with degenerative arthritis ($P = 0.006$), in patients with presence of a labral injury ($P < 0.001$), and in patients with residual chondral defects ($P = 0.002$). Fracture type, fixation/excision, and fracture comminution did not have significant bearing on the score ($P > 0.05$). Regression analysis showed the timing of open surgery had no influence on the occurrence of degenerative arthritis and functional outcome scores ($P > 0.05$).

DISCUSSION

Few reports have shown acceptable results with non-operative treatment of femoral head fractures.⁸ Operative treatment is generally preferred to ensure joint congruity, early mobilization, and to prevent long-term complications.⁹ Although Pipkin type I fractures can be fixed or excised,⁶ fixation is usually recommended for type II fractures.⁷ Anterior surgical dislocation is widely recommended for operative treatment,^{8,9} which can be performed either through a Smith–Peterson¹⁰ or the Ganz approach.^{11,12} The Ganz approach used in the study offered excellent exposure, facilitating easy and safe dislocation of the femoral head, access to all areas of the femoral head and acetabulum to allow internal fixation and labral repair.

We focused on assessing the clinical outcome of these injuries using the Ganz approach with emphasis on the incidence of osteonecrosis of the femoral head. The incidence of osteonecrosis ranges from 8% to 26%¹³ in traumatic hip dislocations, and the incidence is significantly high if the reduction is delayed beyond 6 hours.¹⁴ The timing of initial reduction in hip fracture dislocations and the delay in definitive surgical treatment in unstable and incongruent hips may have a significant bearing on the long-term outcome. By excluding (1) delayed hip reductions, (2) other Pipkin fracture patterns, and (3) performing early open surgery when indicated, we were able to rule out important factors, which could negatively influence the incidence of osteonecrosis.

No osteonecrosis of the femoral head was seen in this study. Ganz et al⁸ have reported a similar outcome for surgical dislocation in a large cohort of 213 patients with variable

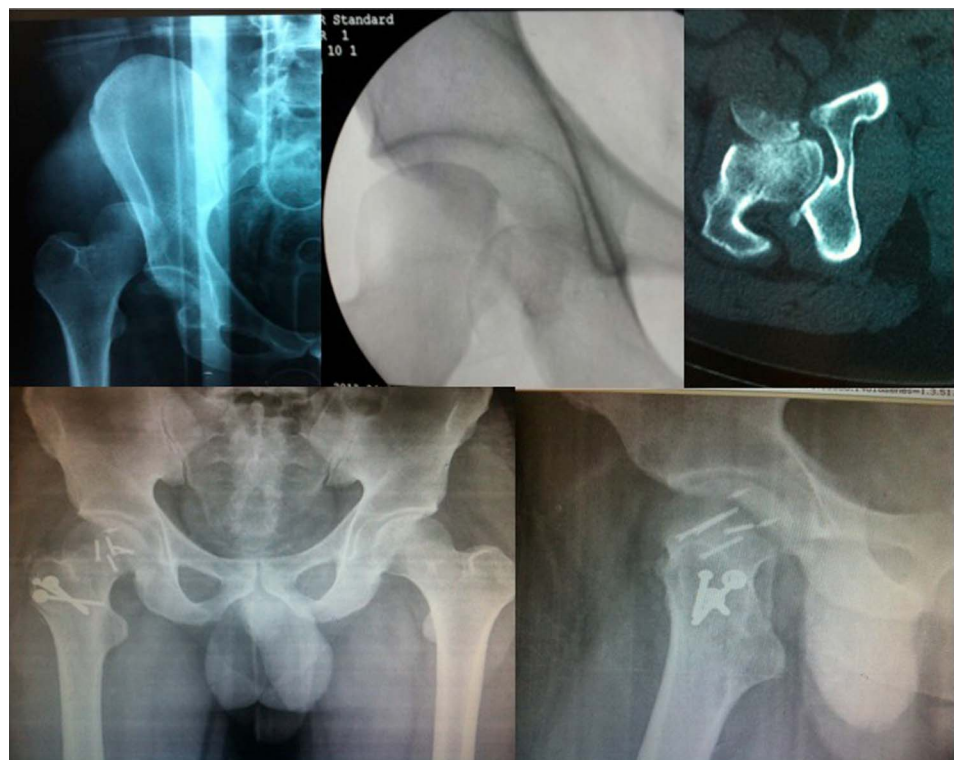


FIGURE 2. A Pipkin type II fracture dislocation showing incongruent hip after reduction. Follow-up radiographs at 3 years show anatomical reduction without evidence of osteonecrosis or arthritis.

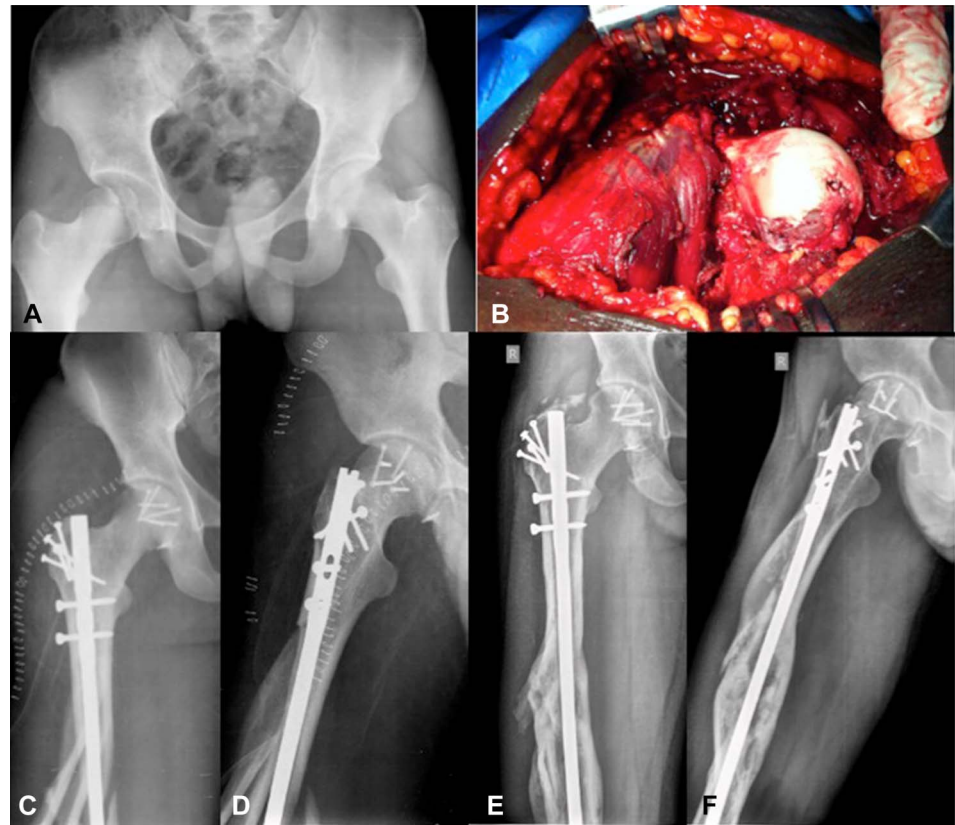


FIGURE 3. A, Type II Pipkin injury in a 23-year male patient demonstrating an incongruent joint after closed reduction. B, Intraoperative image shows extensive chondral damage. C, D, Immediate postoperative x-rays after internal fixation and labral repair showing a congruent hip joint. E, F, Thirty months follow up x-rays show evidence of degenerative hip joint and fixation.

avascular
necrosis

etiological Gardner et al¹⁵ and Kloen et al¹⁶ have previously reported no incidences of AVN using this approach in the treatment of femoral head fractures. Both studies however were retrospective, with small number of patients.

A high percentage of posterior labral avulsions can be seen in these high-energy shear injuries. Labral avulsions were seen in >50% of our patients, which can be easily accessed and repaired through the same approach. Patients with labral avulsions had inferior hip function compared with patients without labral injury. Two-third of patients with degenerative arthritis also had a labral injury but the association did not reach statistical significance.

All 3 patients with arthritic changes had chondral defects or gaps in the superolateral portion of the femoral head, which could not be addressed with internal fixation. Defects or gaps in the weight-bearing area are known to increase the contact stresses predisposing to early degeneration.¹⁷ Associated labral injuries and presence of cartilaginous defects in the weight-bearing area may also be an independent risk factor for a poor outcome in these fractures. A direct causal relationship, however, could only be established with a level I control-based trial.

To our knowledge, this is the first prospective study on the use of Ganz surgical dislocation for femoral head fractures. Strict inclusion criteria, homogenous fracture types, mean follow-up of 3 years, and a high rate of follow-up are the strengths of the study. Lack of controls is a limitation of this study. Ganz approach provides excellent exposure for operative treatment of type I and II Pipkin injuries, without

risk of osteonecrosis in patients undergoing hip reduction with in 6 hours of injury.

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