Use of a Trochanteric Flip Osteotomy Improves Outcomes in Pipkin IV Fractures

Brian D. Solberg MD, Charles N. Moon MD,
Dennis P. Franco MD

Received: 24 March 2008 / Accepted: 26 August 2008 / Published online: 18 September 2008
© The Association of Bone and Joint Surgeons 2008

Abstract The optimal surgical approach for combined femoral head and acetabular fractures (Pipkin IV) is controversial because of their rarity and lack of definitive reports. Surgical dislocation with trochanteric flip osteotomy (TFO) allows simultaneous exposure of the acetabulum and femoral head. We protected the obturator internus and inferior capsule during repair with a heavy suture at the inferior extent of the traumatic capsulotomy. We retrospectively reviewed 12 patients with Pipkin IV fractures treated using this approach during a 6-year period. The minimum followup was 24 months (mean, 47 months; range, 24–71 months). Clinical outcomes were measured using the Merle d'Aubigné-Postel and Thompson-Epstein scoring scales. Radiographically, all patients achieved healing of their acetabular fractures; 11 achieved healing of the femoral head fracture and osteonecrosis developed in one patient. The average Merle d'Aubigné-Postel score was 15.6 of 18; using the Thompson-Epstein score, 10 of the 12 patients had good or excellent outcomes, one had a fair outcome, and one had a poor outcome. Trochanteric flip osteotomy allowed for simultaneous exposure and repair of both lesions in Pipkin IV fractures. Using a uniform surgical

protocol with TFO rendered clinical results comparable to previously reported outcomes in series of isolated femoral head fractures.

Level of Evidence: Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Combined femoral head and acetabular fractures (Pipkin IV) are relatively rare injuries with an incidence of one in seven to one in 15 traumatic hip dislocations in adults [2, 3, 5, 6, 10, 14, 18, 21] (Fig. 1). The original description of Pipkin fractures by Thompson and Epstein included a heterogeneous group of hip dislocations and fractures [14, 20]. They concluded a majority could be treated with observation and traction or fragment excision in cases with femoral head comminution. Currently, evidence supports treatment of isolated, displaced femoral head fractures through a modified anterior (Smith-Petersen) approach with approximately 80% good and excellent long-term outcomes using the Merle d'Aubigné-Postel scoring system [2, 4, 9, 11, 15, 17]. The optimal surgical approach for combined lesions remains controversial because of the inability to address both fractures through a single surgical approach. No outcomes data are available regarding the use of combined anterior and posterior approaches for Pipkin IV fractures. Some authors believe repair of the posterior wall fracture is essential to restore hip stability and should take priority surgically, but it is unclear whether concomitant repair of the femoral head is warranted [15, 17, 19].

Larger series suggest Pipkin IV fractures have poorer outcomes compared with isolated femoral head fractures [9, 15, 17, 19]. Drawing meaningful conclusions from the

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution has approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

B. D. Solberg (✉), C. N. Moon, D. P. Franco
Department of Orthopaedic Surgery, Cedars Sinai Medical
Center, 444 South San Vicente Boulevard, Suite 603,
Los Angeles, CA 90048, USA
e-mail: brian.solberg@cshs.org

Fig. 1 The typical radiographic appearance of a Pipkin IV fracture after closed reduction of hip dislocation is shown. The intraoperative photograph was taken of the right hip in the lateral decubitus position with directional orientation indicated.

data is difficult because of the rarity of the injury and heterogeneity of the surgical approaches used to treat them in these series [9, 15, 17]. Surgery for Pipkin IV fractures generally has focused on repair of the posterior wall fractures through a standard posterior (Kocher-Langenbeck) approach [2, 17–19]. Problems included considerable risk of femoral head osteonecrosis (ON) using the posterior approach and inability to simultaneously address the anterior femoral head fracture without a second approach. Trochanteric flip osteotomy has been described for management of femoral-acetabular impingement, acetabular fractures, and femoral head fractures [7–9, 16]. This technique allows simultaneous exposure and repair of both elements of Pipkin IV fractures without compromising the femoral head vasculature [12].

We report the radiographic outcomes, including rates of ON and heterotopic ossification, and clinical outcomes using the Merle d'Aubigné-Postel and Thompson-Epstein scoring systems in 12 patients with Pipkin IV fractures managed surgically with a TFO approach during a 6-year period.

Materials and Methods

We retrospectively reviewed the records and radiographs of 15 patients treated with a TFO for Pipkin IV fractures between May 2000 and January 2006. During this same time, 67 patients presented to our institution with traumatic posterior hip dislocation. Inclusion criteria were

documented posterior hip dislocation in an adult, Pipkin IV fracture with greater than 2 mm displacement of the femoral head or acetabular fragment, and complete radiographic and clinical followups for a minimum of 24 months (mean, 47 months; range, 24–71 months). Complete radiographic and clinical followup data were available for 12 of the 15 patients and these 12 patients constitute the basis of the report. Ten patients were male and two were female. Associated injuries were present in 10 of the 12 patients with an average Injury Severity Score of 17 (range, 9–42). No patients were recalled specifically for this review. Three patients were lost to followup. Institutional Review Board approval was obtained for retrospective data analysis.

We classified fracture patterns using the Pipkin, Brumback, and Orthopaedic Trauma Association classifications [1, 13, 14]. Ten patients had infrafoveal femoral head fractures we classified as Brumback Type 1B, and two patients had a transfoveal fracture classified as Type 2B. Using the Orthopaedic Trauma Association classification, all femoral head fractures were Type 31.C1; 11 acetabular fractures were Type 62.A2 (posterior wall); and one was a Type 62-B2.3a [3] (transverse posterior wall).

Patients presenting to our emergency department had closed reduction of the hip dislocation in the emergency department within 1 hour of presentation. All patients underwent CT of the pelvis with 3-mm cuts through the acetabulum and proximal femur. Patients with continued hip instability after closed reduction were treated with distal femoral traction.

We performed the surgery with the patients in the lateral position on a standard flat radiolucent table using the previously described technique for TFO. The piriformis was tagged and released, but the short external rotators (gemelli and obturator internus) and inferior capsule were preserved during the approach. We identified the posteroinferior-most extent of the traumatic capsulotomy and protected it with a heavy suture to prevent further inferior extension of the capsulotomy at the time of surgical dislocation (Fig. 2). The femoral head fracture was repaired first with headless variable-pitch screws (Accutrak; Acumed, Hillsboro, OR, or Herbert; Zimmer, Warsaw, IN) countersunk below the articular surface (Fig. 3). The repaired femoral head then was reduced and used as a template for posterior wall repair using standard pelvic plates (Stryker, Mahwah, NJ; Synthes, West Chester, PA). None of the acetabular fractures extended below the level of the obturator internus and were exposed in the cephalad portion of the TFO approach. The superior portion of the posterior column was exposed by subperiosteal elevation of the gluteus minimus allowing access to the anterior aspect of the fracture. The trochanteric osteotomy was repaired using either 3.5-mm cortical screws or 6.5-mm cancellous screws. The overlying

Fig. 2 The inferior margin of the traumatic capsulotomy is identified and protected with a tag suture. The intraoperative photograph was taken of the right hip in the lateral decubitus position with directional orientation indicated. GMED = gluteus medius; G MIN = gluteus minimus; OI = obturator internus; PI = piriformis tendon; Q = quadratus femoris; VLAT = vastus lateralis; Ant = anterior; Inf = inferior; Post = posterior; Sup = superior; FH = femoral head.

structures were closed over a small suction drain. At the time of surgical repair, there was no active bleeding from the inferior head fragment in 11 of 12 cases; limited bleeding occurred in one case. Eleven patients underwent femoral head repair and one patient had excision of the femoral head fragments. Labral tears were present in all patients and were located in the superior acetabular rim. Seven of 12 tears were firmly adherent to the posterior wall fragment and were repaired indirectly by osteosynthesis. The other five were detached from the posterior wall fragments and excised. Average surgical time was 121 minutes (range, 102–215 minutes); average blood loss was 350 mL (range, 250–750 mL); and the average time to surgery was 3 days postinjury (range, 1–12 days).

Postoperatively, pain was managed with patient-controlled analgesia for the first 48 hours. We applied

Fig. 3 A displaced femoral head fracture after hip dislocation is shown. The intraoperative photograph was taken of the right hip in the lateral decubitus position with directional orientation indicated. GMED = gluteus medius; G MIN = gluteus minimus; OI = obturator internus; PI = piriformis tendon; Q = quadratus femoris; VLAT = vastus lateralis; Ant = anterior; Inf = inferior; Post = posterior; Sup = superior; AC = anterior capsule; FH = femoral head; La = acetabular labrum; TO = trochanteric osteotomy.

sequential compression stockings intraoperatively and patients were administered low-molecular-weight heparin (Fragmin [Pfizer-Eisai, Woodcliff, NJ] or Lovenox [Sanofi Aventis, Bridgewater, NJ]) starting on postoperative Day 1 and continued for 14 days. Radiation therapy (700 cGy) was administered within 48 hours of surgery to prevent heterotopic ossification. Duplex ultrasound was performed routinely before discharge to rule out deep venous thrombosis. One patient had wound dehiscence treated with local wound care and antibiotics. None of the patients had deep venous thrombosis by screening ultrasound. Patients were kept touchdown weightbearing for 6 weeks followed by gradual weightbearing and gait training with full weightbearing by 8 weeks after surgery.

Fig. 4A–B (A) Iliac and (B) obturator oblique-view radiographs taken at 41 months followup show maintenance of reduction without degenerative changes.

We followed patients clinically and radiographically at 4 and 8 weeks postoperatively and every 3 months afterward. At each time, patients were examined by the treating surgeon for active range of motion, passive range of motion and power, gait assessment, activity of daily living assessment, visual analog pain scale assessment, and oblique (Judet view) radiographs of the repaired hip. Clinical outcome scores were calculated using the Merle d'Aubigné-Postel [4] and Thompson and Epstein [20] scales. The Merle d'Aubigné-Postel scale is a numeric scale with a maximum of 18, which accounts for pain and functional outcome, whereas the Thompson-Epstein scale accounts for pain, function, and radiographic appearance and is graded as excellent, good, fair, or poor.

Radiographs were independently reviewed by one skeletal radiologist (JD) for evidence of nonunion, heterotopic ossification, and/or ON (Fig. 4). Heterotopic ossification was graded using the Brooker classification based on appearance on the Judet-view radiographs [1].

Results

Eleven of the 12 patients had radiographic union of both fractures without loss of fixation, hardware failure, or progressive loss of joint space at latest followup. Trochanteric osteotomies were visible radiographically for an average of 23 weeks (range, 14–33 weeks); one patient had ON of the femoral head develop and underwent revision surgery to a THA 27 weeks postoperatively. Three patients had Brooker Class II heterotopic ossification and one had Brooker Class III heterotopic ossification develop. None of the patients elected to undergo surgical excision of the ectopic bone.

The average Merle d'Aubigné-Postel score was 15.6 of a possible 18. Five patients had scores of 18, five patients scored between 15 and 17, one patient scored 13, and one patient scored 11. Using the Thompson-Epstein scoring scale, 10 of the 12 patients had good or excellent results, one patient with Grade III heterotopic ossification had a fair result, and one patient with ON had a poor result.

Discussion

Pipkin IV fractures have been well described in the literature, but meaningful conclusions have proven difficult because of the heterogeneity of data, even within a given series [2, 3, 5, 6, 10, 11, 14, 18, 21]. Information regarding treatment of the acetabulum or femoral head alone does not allow meaningful conclusions about optimal treatment for combined lesions. We therefore report the radiographic outcomes, including rates of ON and heterotopic

ossification, and clinical outcomes using the Merle d'Aubigné-Postel and Thompson-Epstein scoring systems in 12 patients with Pipkin IV fractures managed surgically with a TFO approach during a 6-year period.

Our study had several limitations. Given the small number of study subjects, contrasts with previous studies are difficult and do not allow for ready comparison. However, we analyzed a single fracture pattern treated with a uniform approach decreasing the heterogeneity of the study group and allowing some conclusions regarding the usefulness of the approach for this fracture type. The Merle d'Aubigné-Postel and Thompson-Epstein scoring systems are less objective outcome measures compared with more modern techniques such as the SF-36 and may overestimate the end result by introducing bias on the part of the surgeon and rater. These scoring systems, however, allowed us to compare our data with historical data using these scoring systems. We do not know whether a more sensitive outcome measure would influence our conclusions. We lost three patients to followup, and given the small numbers, it is unclear whether the data from these patients would alter our data, but we presume a capture of 12 of 15 patients provides representative results.

Our surgical protocol of repairing the femoral head before acetabular fixation was used for two reasons. Leaving the posterior wall unrepaired allowed us to manipulate and observe the femoral head more easily. This was an important factor in femoral head fixation in which the lag screws are placed from an anteroinferior position. Repair of the femoral head fragment restored the effective femoral head diameter, but stability was difficult to assess in patients with posterior wall fractures and concomitant trochanteric osteotomy. Once repaired, the femoral head was congruent in the acetabulum and aided in reduction of the posterior wall fragment. In our patients, the posterior wall fractures were high and did not require release of the obturator internus or inferior extension of the traumatic posterior capsulotomy. We attempted to minimize iatrogenic damage to the medial circumflex perforators by placing a tag suture at the apex of the capsulotomy and not releasing the obturator internus.

Several series have reported poorer outcomes in patients with Pipkin IV fractures than with isolated femoral head fractures [10, 17, 19, 20]. Aside from the presence of ON, the cause of the worse outcomes is unclear. Although nonoperative management of displaced femoral head fragments has been reported to lead to malunion and loss of motion often requiring surgical resection, the majority of isolated infrafoveal femoral head fractures can be treated nonoperatively with good outcomes [22]. Some series of combined fractures have emphasized acetabular repair to stabilize the hip, but it is unclear whether neglect of the femoral head lesion, per se, led to worse outcomes [9]. The

data from our patients suggest repairing the femoral head component of Pipkin IV fractures might lead to better outcomes; however, the necessity of repairing an infrafoveal femoral head component of a combined lesion is unclear. More recent series report the utility of the TFO technique in femoral head fractures [9], but these data did not stratify outcomes based on fracture type. To our knowledge, our report includes the largest series of consecutive Pipkin IV fractures treated using a uniform surgical approach. Our clinical outcomes using a TFO compared favorably with previous data with an overall good to excellent outcome in 80% of patients at an average 4-year followup.

The surgical technique of TFO allowed simultaneous exposure and fixation of acetabular and femoral head fractures. The use of a uniform surgical protocol using the TFO technique gave 80% good and excellent midterm results comparable to reported outcomes of isolated femoral head fractures. The use of a stitch at the caudad apex of the posterior capsular tear may be beneficial in preventing further capsular tearing and vascular compromise of the femoral head.

Acknowledgments We acknowledge Dr. Jeff Dym for assistance in radiographic assessment, Beth Habelow for assistance with our trauma database, and Dr. Jim Mirocha for assistance in statistical evaluation of the data.

References

1. Brooker AF, Brownerman JW, Robinson RA, Riley LH Jr. Ectopic ossification following total hip replacement: incidence and a method of classification. *J Bone Joint Surg Am.* 1973;55:1629–1632.
2. Brumback RJ, Kenzora JE, Levitt LE, Burgess AR, Poka A. Fractures of the femoral head. *Hip.* 1987;181–206.
3. Butler JE. Pipkin Type-II fractures of the femoral head. *J Bone Joint Surg Am.* 1981;63:1292–1296.
4. d'Aubigne RM, Postel M. Functional results of hip arthroplasty with acrylic prosthesis. *J Bone Joint Surg Am.* 1954;36:451–475.
5. Epstein HC. Posterior fracture dislocations of the hip: long-term follow-up. *J Bone Joint Surg Am.* 1974;56:1103–1127.
6. Epstein HC, Wiss DA, Cozen L. Posterior fracture dislocation of the hip with fractures of the femoral head. *Clin Orthop Relat Res.* 1985;201:9–17.
7. Ganz R, Gill TJ, Gautier E, Ganz K, Krugel N, Berlemann U. Surgical dislocation of the adult hip: a technique with full access to the femoral head and acetabulum without the risk of avascular necrosis. *J Bone Joint Surg Br.* 2001;83:1119–1124.
8. Gardner MJ, Suk M, Pearle A, Buly RL, Helfet DL, Lorich DG. Surgical dislocation of the hip for fractures of the femoral head. *J Orthop Trauma.* 2005;19:334–342.
9. Henle P, Kloen P, Siebenrock KA. Femoral head injuries: which treatment strategy can be recommended? *Injury.* 2007;38:478–488.
10. Marchetti ME, Steinberg GG, Coumas JM. Intermediate term experience of Pipkin fracture-dislocations of the hip. *J Orthop Trauma.* 1996;10:455–461.
11. Mowery C, Gershuni DH. Fracture dislocation of the femoral head treated by open reduction and internal fixation. *J Trauma.* 1986;26:1041–1044.
12. Notzli HP, Siebenrock KA, Hemphing A, Ramseier LE, Ganz R. Perfusion of the femoral head during surgical dislocation of the hip: monitoring by laser Doppler flowmetry. *J Bone Joint Surg Br.* 2002;84:300–304.
13. Orthopaedic Trauma Association Committee for Coding and Classification. Fracture and dislocation compendium. *J Orthop Trauma.* 1996;10(suppl 1):1–154.
14. Pipkin G. Treatment of Grade IV fracture-dislocation of the hip. *J Bone Joint Surg Am.* 1957;39:1027–1042; passim.
15. Routt ML, Simonian PT, Hansen ST. Young patients with femoral head fractures. In: Sledge CB, ed. *Master Techniques in Orthopaedic Surgery.* Philadelphia, PA: Lippincott-Raven; 1998:139–153.
16. Siebenrock K, Gautier E, Ziran BH, Ganz R. Trochanteric flip osteotomy for cranial extension and muscle protection in acetabular fracture fixation using a Kocher-Langenbeck approach. *J Orthop Trauma.* 1998;12:387–391.
17. Stannard JP, Harris HW, Volgas DA, Alonso JE. Functional outcome of patients with femoral head fractures associated with hip dislocations. *Clin Orthop Relat Res.* 2000;377:44–56.
18. Swiontkowski MF. Evaluation of outcomes for musculoskeletal injury: intracapsular hip fractures. In: Browner B, Jupiter J (Eds), *Skeletal Trauma.* 2nd Ed. Philadelphia, PA: WB Saunders; 1998: 1751–1832.
19. Swiontkowski MF, Thorpe M, Seiler JG, Hansen ST. Operative management of displaced femoral head fractures: case-matched comparison of anterior versus posterior approaches for Pipkin I and Pipkin II fractures. *J Orthop Trauma.* 1992;6:437–442.
20. Thompson VP, Epstein HC. Traumatic dislocation of the hip: a survey of two hundred and four cases covering a period of twenty-one years. *J Bone Joint Surg Am.* 1951;33:746–778; passim.
21. Warren PJ. Fixation of a fracture of the femoral head with preservation of remaining soft-tissue attachments: a case report. *J Orthop Trauma.* 1991;5:504–505.
22. Yoon TR, Chung JY, Jung ST, Seo HY. Malunion of femoral head fractures treated by partial osteotomy: three case reports. *J Orthop Trauma.* 2003;17:447–450.