Surgery Benefit Pipkin Type I Femoral Head Fractures

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Femoral head fractures are rare injuries with or without traumatic dislocations. The management of these fractures is crucial to prevent the development of severe complications and to achieve optimal functional outcomes. Wide treatment options for Pipkin 1 femoral head fractures range from fragment excision, fixation following open reduction with internal fixation, or conservative treatment such as close reduction alone after fracture dislocation.

femoral fractures hip dislocation fracture fixation arthritis femur head necrosis

1. Introduction

Femoral head fractures are relatively uncommon injuries, with a reported 2 cases per million people per year [1]. Femoral head fractures typically result from high-energy trauma causing compression along the axis of the femur with transmission into the hip joint [2]. Approximately 84% of femoral head fractures result from a high-energy motor vehicle dashboard injury [3][4][5]. Simultaneous hip dislocation [6][7][8][9][10] accounts for 4–17%. To classify and guide definitive treatment of femoral head fractures, the Pipkin classification is most commonly referenced [11][12]. The Pipkin femoral head fracture classification is as following: Type I- fracture is inferior to the fovea capitis femoris, the non-weight bearing surface of the femoral head; Type II- fracture is superior to the fovea capitis femoris, the weight bearing surface of the femoral head; Type III- Either Type I or II with associated femoral neck fracture; Type IV- Either Type I or II with associated acetabular fracture. Treatment options for Pipkin Type I and II injuries include non-operative management if closed reduction achieves <1–2mm displacement and an anatomic congruent hip joint without evidence of fragment interposition [11]. Surgical treatment options include fragment excision or open reduction internal fixation. Of note, Type I and II fractures are associated with better outcomes when compared to Type III and IV fracture patterns [11]. Giannoudis PV et al. conducted a systematic review and reported that 21% of Pipkin type 1 fractures are treated nonoperatively [3]. Pipkin et al. preferred closed reduction alone for these injuries [11]. However, surgery may be indicated if a comminuted fracture fragment prevented successful reduction of the hip joint. Complications, including heterotopic ossification (HO), avascular necrosis (AVN), and post-traumatic arthritis can limit patient's hip function and postoperative outcomes [6][13][14][15][16][17].

Current evidence is limited on reporting femoral head fracture outcomes according to classification, especially the outcomes in early stage. Guo et al. conducted a systematic review of 10 studies of 176 patients assessing the surgical approach on postoperative femoral head fractures and the development of HO and AVN, revealing that the use of the anterior approach results in a higher risk of HO, while the posterior approach may increase AVN risk [16]. Masse et al. reported that among 13 femoral head fracture patients treated surgically, one patient developed AVN,

one developed post-traumatic arthritis, and two developed HO [18]. Furthermore, Lin et al. evaluated mid and long term results of trochanteric flip osteotomy of 9 type I and 14 type II Pipkin femoral head fractures patients. HO, AVN, and post-traumatic arthritis developed in 3,2, and 1 patients, respectively [19].

The optimal treatment for Pipkin type 1 femoral head fractures remains controversial due to mixed results.

2. Surgery Benefit Pipkin Type I Femoral Head Fractures

With regards to mechanism of injury, femoral head fractures typically occur following motor vehicle injury and associated dashboard injuries. 89.7% of patients sustained a femoral head fracture following a MVA while 5.2% and 1.0% of patients fell from either a height or direct impact from falling debris, respectively. Early detection and closed reduction are critical in the initial patient management, especially among poly-trauma patients as femoral head fracture can be undetected.

Type I Pipkin femoral head fractures are inferior to the fovea capitis femoris, the non-weight bearing surface of the femoral head. Appropriate treatment options for Pipkin Type I femoral head fractures must consider joint reduction, hip stability, and congruent joint line. The presence of intra-articular incarcerated fragments impedes a congruent joint reduction [20][21][22]. Chakraborti et al. recommended that conservative management should always be considered first [23]. Historically, femoral head fractures were treated conservatively with prolonged bed rest, in-line traction, and closed reduction. Non-operative management in Pipkin Type I femoral head fractures can be considered if closed reduction achieves <1–2mm displacement and an anatomic congruent hip joint without evidence of fragment interposition. Henle et al. reported that only 1 of 12 patients was in anatomic position following closed reduction [2]. In our analysis, conservative treatment with closed reduction alone for the dislocated hip joint increased the rate of posttraumatic arthritis as well as leading to poor Merle' d Augine and Postel outcome scores. Supporting our findings, Chen et al. conducted a randomized control trial to assess functional outcomes of 16 Type I Pipkin fractures who either receive closed reduction or closed reduction with fragment excision [24]. Thompson and Epstein and Merle d'Aubigne and Postel scores were both worse for conservative treatment with closed reduction alone ($p = 0.032$).

Holmes et al. conducted a biomechanical cadaveric study indicating that excision of a small part (<1/3) of the non-weight-bearing surface does not lead to adverse long-term clinical implications [25]. Contrastingly, the literature has reported that retained intracapsular fragments contribute to synovial joint degeneration, chondrocyte apoptosis, and soft tissue destruction [26].

Fragment size is also critical to predict the prognosis such as the rates of posttraumatic arthritis, AVN, and HO. To further guide appropriate treatment of different fragment size in Pipkin Type I, Yoon et al. modified this classification to: (a) small fragment or several fragments require fragment excision; (b) large fragment requires fragment anatomical reduction [27]. Unfortunately, most studies did not show a consistent inclusion criteria of fragment size. Therefore, the role of different fragment size which impact on treatment decision was difficult to draw conclusions from the literature [27].

Fragment excision as well as open reduction internal fixation are viable surgical options for isolated femoral head fracture, yet results remain inconclusive. Pape et al. reported that 75% of patients reported satisfactory outcomes following closed anatomic reduction alone of Pipkin Type I femoral head fractures as compared to 64% and 50% who either underwent ORIF or fragment excision, respectively. Contrastingly, Giannoudis et al. reported that among 71 Pipkin Type I femoral head fractures, patients who underwent fractured fragment excision reported an 86.7% “excellent” or “good” Thomson-Epstein functional outcome scores, yet not significant when compared to ORIF patients (p = 0.07). Furthermore, Epstein et al. reported that among 242 posterior-femoral head fracture dislocations, satisfactory results were achieved in 12%, 42%, and 63% of patients that either received closed reduction alone, closed reduction followed by open reduction, and primary open reduction, respectively [25].

The results indicate that fragment excision had better functional outcomes in both Thompson Epstein and Merle’ d Augine and Postel Scores when compared to conservative treatment alone or ORIF. We suggest a conservative treatment with closed reduction as the first step for these types of injuries. If a noncongruent hip joint remains, excision or ORIF should be considered accordingly to the fragment size. A small fragment may be excised while a large fragment may be treated with ORIF by screw fixation.

3. Conclusions

This entry demonstrated the clinical outcomes of Type I Pipkin Femoral head fractures and how they differ among procedures. A fragment excision may achieve better function; conservative treatment might result in a higher arthritis rate, and ORIFs may have higher avascular necrosis incidence. These findings may assist surgeons in tailoring their decision-making to specific patient profiles. Future multicenter randomized controlled trials are required to validate associations found in this study.

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