

# Modified Kocher-Langenbeck approach in combined surgical exposures for acetabular fractures management

Narender Kumar Magu, Rajesh Rohilla, Amanpreet Singh, Jitendra Wadhvani

## ABSTRACT

**Background:** Displaced fractures of the acetabulum are best treated with anatomical reduction and rigid internal fixation. Adequate visualization of some acetabular fracture types may necessitate extensile or combined anterior and posterior approaches. Simultaneous anterior iliofemoral and posterior Kocher-Langenbeck (K-L) exposures with two surgical teams have also been described. To assess whether modified Kocher-Langenbeck (K-L) approach can substitute standard K-L approach in the management of elementary acetabular fractures other than the anterior wall and anterior column fractures and complement anterior surgical approaches in the management of complex acetabular fractures.

**Materials and Methods:** 20 patients with transverse and associated acetabular fractures requiring posterior exposure were included in this prospective study. In 9 cases (7 transverse, 1 transverse with posterior wall, and 1 posterior column with posterior wall), stabilization was done through modified K-L approach. In 11 cases (3 transverse and 8 associated fractures), initial stabilization through iliofemoral approach was followed by modified K-L approach.

**Results:** The average operative time was 183 min for combined approach and 84 min for modified K-L approach. The postoperative reduction was anatomical in 17 patients and imperfect in 3 patients. The radiological outcome was excellent in 15, good in 4, and poor in one patient. The clinical outcome was excellent in 15, good in 3 and fair and poor in 1 each according to modified Merle d'Aubigne and Postel scoring system.

**Conclusion:** We believe that modified K-L approach may be a good alternative for the standard K-L approach in the management of elementary fractures and associated fractures of the acetabulum when combined with an anterior surgical approach. It makes the procedure less invasive, shortens the operative time, minimizes blood loss and overcomes the exhaustion and fatigue of the surgical team.

**Key words:** Acetabular fractures, transverse fractures, iliofemoral approach, ilioinguinal approach, Kocher-Langenbeck approach, modified Kocher-Langenbeck approach

**MeSH terms:** Acetabulum, fracture, bone, fracture fixation

## INTRODUCTION

Displaced fractures of the acetabulum are best treated with anatomical reduction and rigid internal fixation.<sup>1-3</sup> Superior outcomes are associated with anatomic reduction of the weight bearing dome of the acetabulum.<sup>1</sup> Most of the acetabular fractures (98%) can be managed by a single appropriate operative approach.<sup>1</sup>

However, adequate visualization of some acetabular fracture types may necessitate extensile or combined anterior and posterior approaches.<sup>1</sup> The triradiate, extended iliofemoral, the modified extensile approach and combined anterior and posterior exposures are the various techniques described.<sup>4-8</sup> Combined surgical approaches have been described as staged procedures under the same anesthesia or at different operative settings. Even simultaneous anterior iliofemoral and posterior Kocher-Langenbeck (K-L) exposures with two surgical teams have also been described.<sup>5</sup> Increased rates

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Access this article online	
Quick Response Code:	Website: www.ijoonline.com
	DOI: 10.4103/0019-5413.177570

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**How to cite this article:** Magu NK, Rohilla R, Singh A, Wadhvani J. Modified Kocher-Langenbeck approach in combined surgical exposures for acetabular fractures management. Indian J Orthop 2016;50:206-12.

of infection, heterotopic ossification, poor visualization of fracture, flap complications, increased operative time and blood loss, and surgeon's fatigue are some of the disadvantages of extensile and standard combined surgical approaches.<sup>4-9</sup>

A previous study had described a modification of the standard K-L approach for the treatment of select posterior wall fractures of the acetabulum, which aimed at achieving osteosynthesis by creating two windows: Between the gluteus medius and piriformis muscles superiorly and between the external rotators and ischial tuberosity inferiorly.<sup>10</sup> The approach spares the division of short external rotators and abductors of the hip, thus preventing iatrogenic damage to the vascularity of head of the femur and fracture fragments.<sup>10</sup> The technique is biological and has the potential of lesser operative time and less blood loss with decreased incidence of heterotopic ossification. It has been our endeavor to use modified K-L approach instead of standard K-L approach as an initial attempt to stabilize fractures necessitating posterior exposure. In this prospective study, we aim to evaluate: (1) Can modified K-L approach substitute standard K-L approach in the management of elementary acetabular fractures other than anterior wall and anterior column fractures; (2) and be an alternate approach when combined with anterior surgical approach in the management of complex acetabular fractures; (3) and finally, to evaluate the quality of reduction, radiological and functional outcome of patients operated in (2) and (3).

## MATERIALS AND METHODS

Twenty patients (16 males and 4 females) with transverse and associated fractures requiring posterior approach operated between 2006 and 2014 were included in this prospective study. The study was approved by the Institutional Review Board. Patients sustaining fracture of the acetabulum at author's tertiary level institute operated with modified K-L approach alone or in combination with iliofemoral/ilioinguinal approach were included in the study. The indications of modified K-L approach were displaced acetabular fractures with or without dislocation, presence of osteochondral intraarticular fragments or unstable hip and associated sciatic nerve palsy. Mean age was 29 years (range 18–55 years). The right acetabulum was involved in 11 patients while the left was involved in 9 patients. The causes of injury were road-traffic accidents ( $n = 14$ ), fall from a height ( $n = 6$ ). All patients underwent plain radiographs of the pelvis (anteroposterior and 45° oblique Judet views); and computed tomography (CT) scans with three-dimensional reconstruction preoperatively. Fractures were classified according to the criteria of Letournel and Judet.<sup>11</sup> The distribution of fractures were as follows:

10 transverse, 5 both column, 2 T-shape, 1 transverse with posterior wall, 1 posterior wall with posterior column, and 1 anterior wall with posterior hemi-transverse [Table 1]. Two patients had associated sciatic nerve palsy at the time of admission. Two patients had associated injuries of the upper extremities. The average time between injury and surgical procedure was 9.5 days (range 3–36 days). All surgeries were performed by the first author.

The treatment protocol for patients with acetabular fractures involved initial closed reduction of dislocation if present under sedation/anesthesia followed by preoperative longitudinal upper tibial skeletal traction with weights up to 7.5–10 kg.

The fracture pattern, displacement of column and quality of bone stock conducive to provide stable fixation decided the surgical approach and positioning of the patient. The modified K-L approach was used for posterior exposure and iliofemoral/ilioinguinal approach for anterior exposure. The modified K-L approach was the usual approach in transverse fractures. If the fracture line crossed the acetabulum from proximal anterior to distal posterior and the displacement was more anteriorly, the anterior approach was selected initially. In 9 cases (7 transverse, 1 transverse with posterior wall, and 1 posterior column with posterior wall), stabilization was done through modified K-L approach. In 11 cases (3 transverse and 8 associated fractures), stabilization through iliofemoral approach was followed by modified K-L approach.

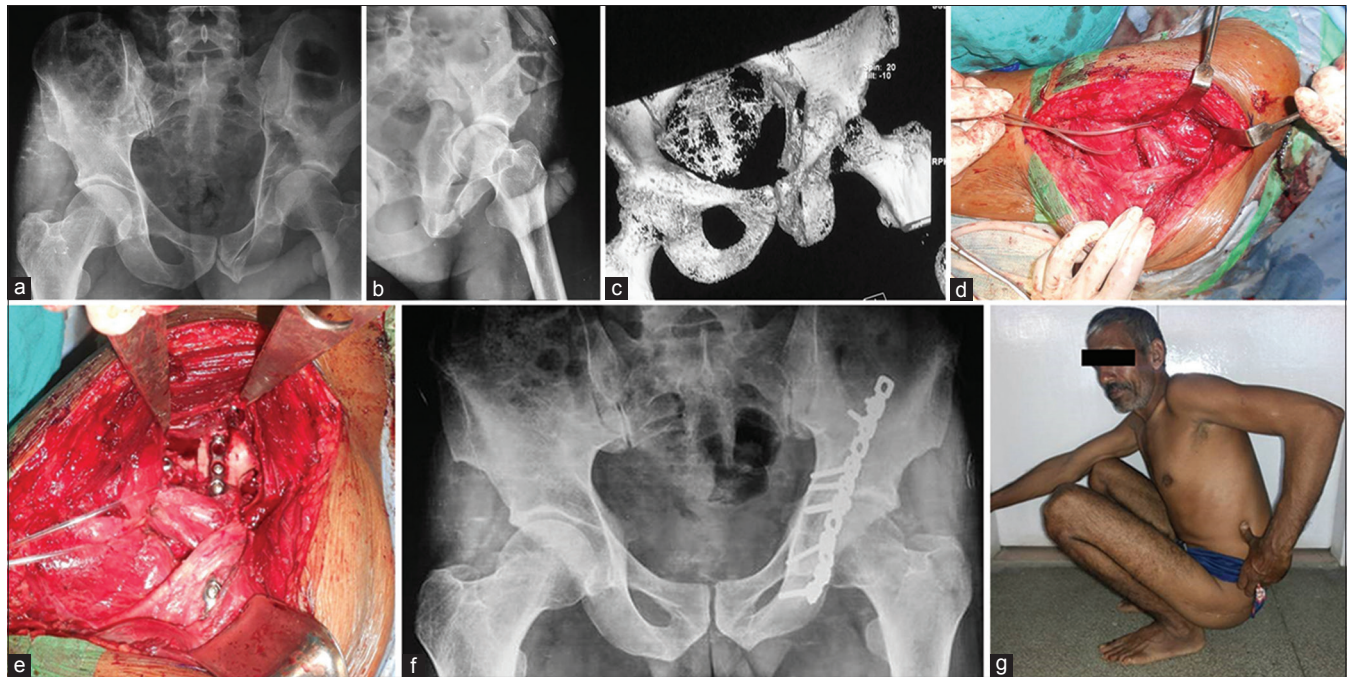
## Operative procedure

All patients were prepared and draped in a floppy lateral position. Operative position was made considering the order of fixation of posterior or anterior column. All fracture types involving the posterior column were exposed and stabilized through modified K-L approach<sup>10</sup> in floppy lateral position with the affected hip on the upper side. Rotation of the ischio-pubic fragment was assessed by inserting the index finger through the greater sciatic notch and any displacement if observed was simultaneously corrected with the available tools. The neglected transverse fractures were cleared of the fibrous tissue and intervening callus through the two windows while using modified KL approach for the easy mobilization and reduction of the fractured columns [Figure 1a-g]. The patient was turned to supine position for subsequent fixation through anterior exposure when required. The hip was flexed to relax the iliopsoas muscle in order to expose part of the anterior column 3–4 cm distal to the iliopectineal eminence using narrow tip Hohmann bone levers. This makes enough room for sliding the contoured reconstruction plate under the iliopsoas muscle to stabilize the anterior column.

**Table 1: Details of 20 patients included in the study**

Age (years)	Type of fracture	Duration since injury (days)	Approach	Postoperative reduction	Final radiological outcome	Final d'Aubigne and Postel scores
22	Both column	12	Combined (A + P)	Anatomical	Excellent	Excellent
22	Transverse	36	Combined (callus from postapproach)	Anatomical	Excellent	Excellent
25	Both column	10	Combined with flip	Anatomical	Good	Good
32	Transverse	12	Modified K-L approach	Anatomical	Excellent	Excellent
35	Both column + posterior wall + dislocation	8	Combined	Anatomical	Excellent	Excellent
29	Transverse	6	Modified K-L approach	Anatomical	Excellent	Excellent
34	Both column	7	Combined	Anatomical	Excellent	Excellent
19	T-shape with central dislocation	3	Combined	Anatomical	Excellent	Excellent
40	Transverse	10	Mod K-L approach	Imperfect	Good	Good
28	Transverse	12	Combined	Imperfect	Poor	Poor
36	Both column	3	Combined	Anatomical	Good	Fair
40	Transverse fracture with central subluxation	17	Combined	Anatomical	Excellent	Excellent
26	Postcolumn with posterior wall	10	Modified K-L approach	Anatomical	Excellent	Excellent
22	Transverse fracture with central dislocation	6	Modified K-L approach	Anatomical	Excellent	Excellent
29	Transverse	8	Modified K-L approach	Anatomical	Excellent	Excellent
36	T shape fracture	3	Combined	Anatomical	Excellent	Excellent
18	Transverse	3	Modified K-L approach	Anatomical	Excellent	Excellent
29	Transverse	7	Modified K-L approach	Imperfect	Good	Good
32	Transverse with posterior wall	3	Modified K-L approach	Anatomical	Excellent	Excellent
55	Anterior wall with posthemi	14	Combined	Anatomical	Excellent	Excellent

K-L=Kocher-Langenbeck



**Figure 1:** (a) Preoperative anteroposterior radiograph of pelvis of a 55-year-old male showing anterior column with posterior hemitransverse fracture of the left acetabulum. (b) Preoperative oblique iliac view of the same patient showing anterior column with posterior hemitransverse fracture (c) Three-dimensional computed tomography reconstruction image of the fracture. (d) Intraoperative photograph showing an intact soft tissue sleeve of short external rotators. The feeding tube may be used to retract the soft tissue sleeve of short rotators while sliding the reconstruction plate from the superior to inferior window. (e) Intraoperative photograph with modified Kocher-Langenbeck approach shows a 3.5 mm reconstruction plate slid under the soft tissue sleeve of the muscles from the superior window towards the ischial tuberosity. (f) Antero-posterior radiograph at 3 years followup showing congruent reduction and excellent radiological outcome. (g) Clinical photograph showing excellent range of motion of left hip

The patient was kept in supine position if anterior exposure was required initially. The iliac crest was divided at its

highest point longitudinally to include anterior superior iliac spine with a motorized saw or a sharp osteotome

1 cm distal to its superior surface. Thus, approximately 5 cm × 1.5 cm chunk of iliac crest carrying anterior superior iliac spine and inguinal ligament was retracted medially to expose iliopubic component of transverse fracture and iliac fossa up to sacroiliac joint. This made room for the palpation of the medially displaced posterior column. Positioning of the patient from supine to floppy lateral and vice versa could be changed to facilitate reduction and fixation through either or both of the anterior and modified K-L exposures.

Interfragmentary compression screws were used wherever possible. The safe placement of the screws was assessed by confirming the fixation under image intensifier. The wounds were closed in layers over closed suction drainage tubes. The drains were removed 48–72 hrs after the operation. Active assisted and pain free passive range of motion exercises in all planes were advised. The patients were encouraged to use crutches and touch toe weight-bearing on the affected extremity postoperatively. Partial weight bearing was permitted after 6 weeks and full weight-bearing with a single crutch or a cane after 10–12 weeks. Unprotected weight bearing was advised after complete healing of the fracture.

The reduction of the fracture was evaluated by measuring the residual displacements on the three postoperative radiographs (anteroposterior and two 45° oblique Judet views). According to the criteria developed by Matta<sup>1</sup> the postoperative reduction is graded as anatomical (0–1 mm of displacement), imperfect (2–3 mm of displacement) and poor (more than 3 mm displacement). The final followup radiographs were graded according to the criteria developed by Matta.<sup>1</sup> According to these criteria, a grade of excellent is given to a normal appearing hip joint, good denotes mild changes with minimal sclerosis and joint narrowing, fair indicates intermediate changes with moderate sclerosis and joint narrowing (<50%) and poor signifies advanced changes. At the final followup examination, the functional outcome was evaluated using a modification of the clinical grading system developed by Merle d'Aubigne and Postel and as modified by Matta.<sup>1</sup> Avascular necrosis of femoral head was classified according to the Ficat and Arlet classification.<sup>12</sup> Heterotopic ossification was graded according to the classification system of Brooker *et al.*<sup>13</sup> The average followup was 3.55 years (range 2–7 years).

The authors certify that the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000.

## RESULTS

The average operative time was 183 (range 156–220 minutes) minutes for combined approach and 84 (range 74–110 minutes) minutes for modified K-L approach. Average blood loss during the operation was 485 ml (range 420–525 ml) for combined approach and 165 ml (range 150–175 ml) for isolated modified K-L approach. Modified K-L approach was attempted in 20 patients [Figure 2a-g] and was successful in all but two patients. In two cases, we only partially divided the short rotators to have a better view of the fracture through the superior window between the piriformis and the short rotators. In one patient having 5 weeks old neglected transverse fracture, modified K-L approach was used to excise fibrous tissue and callus from the fracture site through the superior and inferior windows. Anatomical reduction and stable fixation were performed through iliofemoral approach. No prophylaxis (indomethacin or radiation) against heterotopic ossification was used. One patient had postoperative sciatic nerve palsy which recovered over the period of 6 months postoperatively. The postoperative reduction was graded as anatomical in 17 patients, imperfect in 3 and poor in none. No patient had recurrent dislocation or pulmonary embolism. One patient with transverse fracture stabilized through modified K-L approach had revision fixation as reduction could not be maintained and redo surgery had to be done through combined surgical exposures. The radiographs at final followup revealed a Brooker class III periarticular ossification and avascular necrosis of the head of the femur in one patient. No periarticular ossification was observed in any of the remaining patients. The final followup radiographs were graded as follows: Excellent in 15, good in 4 and poor in one patient. The results for clinical outcome according to modified Merle d'Aubigne and Postel scoring system were as follows: Excellent in 15 patients, good in 3 patients, and fair and poor in 1 patient each.

## DISCUSSION

The long term results of operative treatment of acetabular fractures are influenced by numerous factors including the type of fracture and/or dislocation, damage to the femoral head, associated injuries and timings of the operation, quality of reduction, local complications and the surgical approach.<sup>1,14</sup> The adequate visualization of some acetabular fractures for achieving anatomical reduction and fixation may necessitate extensile or combined anterior and posterior approaches to the acetabulum.<sup>1</sup> The purpose of this study was to assess whether modified K-L approach (a) can substitute standard K-L approach in the management of elementary acetabular fractures other than anterior wall



**Figure 2:** (a) Preoperative anteroposterior radiograph of a 32-year-old male showing transverse with posterior wall fracture and broken quadrilateral plate of the right acetabulum (b) Three-dimensional CT reconstruction of the fracture showing anterior portion of the transverse fracture and broken quadrilateral plate. (c) Intraoperative photograph with modified Kocher–Langenbeck approach showing a 3.5 mm reconstruction plate slid under the soft tissue sleeve of the muscles from the superior window toward the ischial tuberosity. The posterior wall fracture has been stabilized with lag screw. (d) Antero posterior radiograph at 5 years followup shows congruent reduction and excellent radiological outcome. (e) Obturator oblique view at 5 years followup showing congruent reduction. (f) Iliac oblique view at 5 years followup. (g) Clinical photograph showing excellent range of motion of right hip

and anterior column fractures, (b) can be combined with anterior surgical approaches in the management of complex acetabular fracture. The study also aimed to evaluate the quality of reduction, radiological and functional outcome of patients operated with modified K-L approach alone or in combination with iliofemoral approach.

An anatomical reduction was achieved in 85% patients in this study which is comparable to the rates of 71–88% reported in literature.<sup>4-6</sup> We are of the opinion that accurate reduction of the select elementary acetabular fractures other than anterior wall fractures and of high anterior column fractures can be achieved through two windows of the modified K-L approach. The approach can be successfully combined with anterior approach for reduction of most of the transverse and associated acetabulum fractures and neglected fractures. The combined anterior and modified K-L approaches do provide a better view of the fragments of the fracture. Malrotation is a serious limitation of the modified K-L approach and can be corrected while reducing a complex fractures when the approach is combined with an anterior surgical exposure. The superior and inferior

windows serve as an excellent passage for the excision of fibrous tissue and callus in between the columns/fracture fragments to mobilize and reduce the neglected fractures. There is increased risk of incorrect implant position and insufficient reduction while using a soft tissue sparing approach.<sup>15</sup> Roetman *et al.* recommended a CT scan postoperatively to evaluate reduction and osteosynthesis.<sup>15</sup> We advise intraoperative assessment of reduction and fixation under image intensifier. Further, modified K-L approach can be converted to standard conventional approach in case of difficulty in reducing the fracture. In this series, in two cases we only partially divided the short rotators to have a better view of the fracture through the superior window between the piriformis and the short rotators.

The excellent functional outcome was achieved in 75% patients in this study. Arthrosis, necrosis of the femoral head, and heterotopic ossification tend to decline the outcome of acetabular fractures despite good fracture reduction.<sup>15,16</sup> Heterotopic ossification occurs most frequently in patients in whom the gluteal muscles have

been dissected<sup>17</sup> and necrotic gluteus minimus muscle resection diminishes heterotopic ossification formation.<sup>18</sup> We had one case (5%) of grade III heterotopic ossification as compared to rates of 4–16% reported in literature.<sup>4,5</sup> The gluteus minimus muscle is not stripped from the ilium in the modified K-L approach and this might have prevented heterotopic ossification.<sup>10</sup>

The good to excellent radiographic results were observed in 95% of patients in this study. There is a strong association between clinical outcome and radiographic grade.<sup>2,3</sup> Only one patient (5%) had avascular necrosis of femoral head which is comparable to 0–5% reported in literature.<sup>4,5,6,9,19</sup> Preservation of the viability of the fracture fragments and of the femoral head is recommended to improve the functional outcome.<sup>20,21</sup> By working through the windows created on the posterior column in modified K-L approach, the chance of injury to the ascending branch of medial circumflex femoral artery and superior gluteal artery is eliminated.<sup>10</sup> One patient (5%) in this study had iatrogenic nerve palsy as compared to the reported incidence of 4–8%.<sup>4,5,9</sup>

The modified K-L approach in combination with iliofemoral approach was associated with mean blood loss of 515 ml in our hands as compared to 1150–1878 ml reported in literature.<sup>4,5,19</sup> Mean operative time was 183 min in this study as compared to 270–407 min reported in literature.<sup>4,5,19</sup> The decreased blood loss and shorter operative time, in our hands, are the other advantages of the modified K-L approach when combined with iliofemoral approach.

The combined exposures have been reported in 2–4% patients in different studies.<sup>1,22</sup> Routt and Swiontkowski reported sequentially combined exposure in floppy lateral position.<sup>4</sup> The authors used the second approach when an acceptable reduction and fixation could not be achieved with initial exposure as also reported by Matta.<sup>1,4</sup> Harris *et al.* reported simultaneous K-L and iliofemoral exposures of the acetabulum where two surgical teams operated concurrently.<sup>5</sup> The disadvantage of this exposure is the necessity for two surgical teams to be present for the technique to work well.<sup>5</sup> The lateral exposure can make anterior exposure awkward, and simultaneous dual approaches can compromise optimum exposure and reduction possibilities of each.<sup>5</sup> Moroni *et al.* used prone position for posterior exposure and supine position for anterior exposure.<sup>9</sup> But this can lead to increased operative time. We are of the opinion that while reducing a complex fracture through combined surgical approaches, modified K-L approach is suffice to achieve anatomical reduction and stable fixation and a standard K-L approach may not be required. This reduces operative time, blood loss and fatigue of the surgeon. A floppy lateral position makes it

easy for the same surgical team to perform osteosynthesis through anterior and posterior exposures simultaneously at the same sitting.

Simple fractures that require exposure of a single column or wall can be dealt with a single nonextensile approach (K-L, ilioinguinal or iliofemoral).<sup>5</sup> Stabilization of complex acetabular fractures and neglected transverse fractures may warrant combined anterior and posterior surgical approaches for better exposure of fracture fragments. We believe that modified K-L can replace the standard K-L approach most of the times while stabilizing the acetabular fractures requiring fixation with combined approaches. If need be, there is always a place for conversion of modified approach to the standard K-L approach. In the surgical management of complex acetabular fractures or fractures requiring combined surgical approaches, modified K-L approach is an asset to the surgeon, as well as to the patient for achieving biological fixation in a minimal lesser time with minimal blood loss. In another study, the muscle strength measurements in the modified group for flexion/extension and abductor/adductors indicated an increase in maximum work for the injured side, whereas in the standard group, the operated side decreased up to 25%.<sup>23</sup>

Recently, Bozzio *et al.* reported that percutaneous fixation of anterior and posterior column acetabular fractures has the advantage of limiting soft tissue disruption, length of surgery and blood loss when compared with ORIF.<sup>24</sup> We believe that percutaneous fixation of anterior column, when combined with modified K-L approach for fixation of complex acetabular fractures, shall provide anatomical reduction and also reduce operative time, blood loss and prevent complications associated with open reduction techniques.

The limitations of the study are that the fluoroscopic examination is advised before wound closure to assess the quality of reduction and fixation. Distraction by AO distractor to visualize the joint and to remove a loose intraarticular bony fragment may be difficult when muscles are intact. The surgeon may require standard K-L approach in patients with marginal impaction, damage to articular surfaces or associated head fractures. We may require Ganz flip osteotomy when the broken anterior wall is displaced anteriorly. Further surgeon should be skilled in the application of reduction techniques.

Previously it was reported that the modified K-L approach is ideally suited for isolated displaced, noncomminuted posterior wall fractures of acetabulum of <10 days duration without marginal impaction.<sup>10</sup> We believe that modified K-L approach may be a good alternative for the standard K-L

in the management of elementary and associated fractures of the acetabulum either as an isolated posterior approach or in combination with an anterior surgical approach. The approach makes the procedure less invasive, shortens the operative time, minimizes blood loss and overcomes the exhaustion and fatigue of the surgical team. It is safe and retains the advantages of other extensile surgical approaches for achieving quality reduction and minimizes the incidence of complications. A floppy lateral position makes it easy for the same surgical team to perform osteosynthesis through anterior and posterior exposures simultaneously at the same sitting.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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