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# Indications and Outcomes of the Kocher-Langenbeck Surgical Approach in the Management of Acetabular Fractures in a Resource Limited Setting

Handy ED<sup>1\*</sup>, EK Ndifor<sup>1</sup>, AM Itambi<sup>1</sup>, Mbaga AC<sup>1</sup>, Ndikum BN<sup>2</sup>, Fonkoue L<sup>3</sup>, Muluem K<sup>4</sup>, Guifo ML<sup>5</sup>, MA Sosso<sup>6</sup>

<sup>1</sup>Orthopedics and Trauma Unit, Yaounde Central Hospital. <sup>1</sup>Orthopedics and Trauma Unit, Yaounde Central Hospital. <sup>1</sup>Orthopedics and Trauma Unit, Yaounde Central Hospital. <sup>1</sup>Orthopedics and Trauma Unit, Yaounde Central Hospital. <sup>2</sup>Public Health Expert, Elig-Essono Sub-Divisional Medical Centre. <sup>3</sup>Orthopedics and trauma unit, Yaounde Emergency Centre. <sup>4</sup>Orthopedics and Trauma Unit, Yaounde General Hospital. <sup>5</sup>Orthopedics and Trauma Unit, Yaounde University Teaching Hospital. <sup>6</sup>Head of Department, Surgery and Specialties, Faculty of Medicine and Biomedical Sciences, University of Yaounde I.

### ABSTRACT

The Kocher-Langenbeck (K-L) approach is the 'workhorse' of surgery for acetabular fractures needing posterior fixation. It is indicated for most of these fractures for proper surgical technique and optimal outcome. We therefore evaluated the outcome of surgically treated acetabular fractures through the K-L approach in our setting with limited resources. 57 patients were operated by the K-L approach during the 3-year study period. The most common indications of this approach were: posterior wall (38.6%) and transverse + posterior wall fractures (36.8%). Based on Matta's criteria of fracture reduction, 81 % were judged anatomic, 16% imperfect and 3 % poor. A surgery waiting time of 8 to 14 days after injury, significantly favoured anatomic fracture reduction. The MAP score was excellent in 72 % and unacceptable in 10.6 %. Factors associated with poor outcomes were poor fracture reduction and the development of early post-operative complications. Iatrogenic sciatic nerve palsy (ISNP) was the most significant post-operative complication (19.3%). The levering of Hohmann retractors in the sciatic notches was the major risk factor for developing ISNP, compared to the use of sciatic nerve retractors. Other early and late complications included surgical site infections (12.3%) and heterotopic ossification (8.8 %), respectively. The overall outcome following surgery by the K-L approach is satisfactory. However, there is need to ameliorate the technique, especially at the level of instrumentation, to limit post-operative complications.

**Keywords:** Acetabular fractures, Kocher-Langenbeck approach, Outcome.

### \*Correspondence to Author:

Handy Eone Daniel

Telephone: +237 694 74 38 01.

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## INTRODUCTION

Over the past 60 years, following pioneering work by Judet and Letournel, there has been limited clarity regarding the management of acetabular fractures [1,2]. Since their early works [2-4], surgical treatment has become the gold standard for unstable and displaced fractures [5]. Surgical decision-making entails appropriate fracture classification and choosing an adequate surgical approach [6] for the best-planned technique.

A specific approach, the Kocher-Langenbeck's (K-L) approach has been described as the 'work-horse' for the reduction and fixation of acetabular fractures that require fixation via a posterior approach [6,7]. In the Calvacante et al demographic analysis of acetabular fractures treated surgically in Brazil in 2019 [8], the Kocher-Langenbeck approach was used in over 62% fracture repair as the best approach and in about 7% of cases, it was combined with other approaches. This same approach was used in over 80% of Pakistani population in the study by Khan and collaborators in 2013 [9], with results ranging from good to excellent. Proper surgical technique for acetabular surgery must begin with a better understanding of this widely used approach, indicated in the majority of acetabular fractures requiring fixation through a posterior approach. It is relatively easier to carry out by orthopaedic surgeon with less blood loss and satisfactory outcome [10,11]. Approach-related results are however rare in literature, and often have the disadvantage of inhomogeneous patients and acetabular fracture population, with only some early results reported by Letournel [3]. We therefore carried out this study to assess the outcomes of acetabular fractures treated surgically through the Kocher-Langenbeck in Yaounde, a resource limited setting, where no prior studies have been conducted.

## METHODOLOGY

We carried out a 9 months evaluation of patients with acetabular fractures operated through the kocher-langenbeck approach during a 3 year period from January 2018 to December 2020, in five hospitals in Yaounde with acceptable

capabilities to carry out major orthopaedic and trauma interventions. Included in our study, were all patients who were operated for closed acetabular fractures through the K-L approach, who consented to take part. Open acetabular fractures and patients followed up for existent hip osteoarthritis were excluded. Our procedure started with the obtainment of an ethical clearance from the Institutional Review Board of the Faculty of Medicine and Biomedical Sciences of the University of Yaounde I and administrative approvals from managing directors of our recruitment centres. Patients were then seen on the eve of surgery, clerked and informed consent obtained. Baseline socio-demographic characteristics and fracture classification on plain radiograph of the pelvis was done and entered into a data entry form. The patients were then taken for surgery the following morning. During surgery, most patients were positioned prone on ordinary operating tables, without fluoroscopic control. The Kocher-Langenbeck approach was carried out under spinal or GA, with the knee flexed to 90 degrees and maintained by an assistant. After the approach and protection of the sciatic nerve, the fracture patterns were identified. Fractures were reduced with pointed reduction clamps and temporarily fixed with K-wires. Definitive fixation was principally by lag screws and single or double reconstruction plating in buttress mode. Reconstruction was done over 2 tubular aspirative drains. The rest of the questionnaire was filled-out in the post-operative period. Fracture reduction on post-operative control radiographs was assessed by 2 independent orthopaedic surgeons, not involved in the patient management. The Quality of Reduction was defined by Matta's criteria as: anatomic (< 2mm), imperfect (2-3mm) or poor (>3mm). Follow-up visits were then made to coincide with patients' appointment with their treating surgeons. Patient reported outcome was evaluated using the life satisfaction questionnaire-11 (Li-Sat-11) as satisfactory or unsatisfactory. The 9 months functional outcome score was evaluated using the modified Merle-d'Aubigne-Postel score, with a

score of: 18 = excellent; 15-17 = good; 12-14 = fair; 3-11 = poor.

## RESULTS

We recruited a total of 76 patients with acetabular fractures. 11 were managed non-operatively and 5 managed by other classical acetabular approaches. 60 patients were operated through the Kocher-Langenbeck, amongst whom the approach was combined with other standard approaches in 3 patients, and used as the sole approach in 57 patients, who were then followed up for a minimum of 9 months. The population had a mean age of 37 years and was male dominated with a sex ratio of 2.8. Indirect mechanisms, precisely dashboard injuries during high energy road traffic accidents constituted the most common mechanism for acetabular fractures.

The Kocher-Langenbeck approach was the most used approach (87.7%). The most

common indications for this approach were (Table I): Posterior wall fractures (38.6%) and posterior wall + transverse fractures (36.8%). Surgeon's experience evaluated as the median duration of practice was 12.9 years (minimum: 1 year, maximum: 25 years). The number of surgical assistants varied from 2 to 4 assistants, with one assistant responsible for maintaining knee flexion at 90° during surgery. The mean duration of surgery was 168 (±63.6) minutes with an estimated mean blood loss of 600 mL (250-2000 mL). Fracture fixation was mainly by single reconstruction plating (70.2 %) or double plating (29.8 %), majority of which were done in buttress or spring modes. Most simple fracture patterns were fixed by a single reconstruction plate and screws (31/43) and complex fractures were mainly fixed by double reconstruction plating (19/20).

Table I: Indications of the K-L approach

Approach	Indication	Frequency (%)
K-L Approach	Posterior wall	22 (38.6)
	Posterior column	3 (5.3)
	Transverse	6 (10.5)
	Posterior wall + posterior column	3 (5.3)
	T-shaped fracture	2 (3.5)
	Posterior wall + Transverse	21 (36.8)

Fracture reduction according to Matta's criteria was anatomic in about 81 % of cases (Table II). Anatomic reduction was easily obtained in initially undisplaced fractures, although the difference was not statistically significant. A surgery

waiting time of 8 to 14 days significantly favoured the obtainment of anatomic fracture reduction. The timing of surgery above 21 days, was associated with poor fracture reduction.

Table II: Quality of Fracture Reduction according to Matta Criteria following the K-L Approach, (N = 57)

Reduction quality		Frequency	Percentage
Anatomic	Perfect (< 2 mm)	46	80.7
Non-anatomic	Imperfect (2–3 mm)	9	15.8
	Poor (> 3 mm)	2	3.5

The most significant early post-operative complication was iatrogenic sciatic nerve palsy (19.3%). Others complications included surgical site infection (SSI), per-operative haemorrhage

and pressure ulcers. We had no case of thromboembolism and early post-operative death (Table III). The leverage of Hohmann retractors in the sciatic notches was significantly associated

with the development of iatrogenic sciatic nerve palsy, compared with the use of sciatic nerve

retractors or superficial self-retaining retractors (Table VI).

Table III: Early post-operative complications

Complications	Percentage (%)
Iatrogenic sciatic nerve palsy, ISNP	19.3
Surgical Site Infection	12.3
Haemorrhage	10.5
Pressure ulcers	3.5
Non Reduction	1.8
Thromboembolism	0
Death	0

The median duration of hospitalisation following surgery was 12 days (5-100 days), and minimum follow-up period of 9 months. Partial weight bearing was tolerated at an average period of 52 days post-op. All hospital stays longer than 3 weeks involved multiply injured victims or patients with SSI.

Patient reported outcome at 9 months was satisfactory in 95% of cases. The objective clinical and radiographic outcomes were satisfactory in 79% and unsatisfactory in 21% of cases.

The unsatisfactory outcomes were due to sequelae of ISNP (12.3%), avascular necrosis of the femoral head (1.8%), post traumatic

osteoarthritis (3.5%), loss of reduction (5.3%) and Heterotopic ossification (8.8%).

The 9 months functional outcome according to the modified Merle d'Aubigne and Postel score, was excellent in 71.9%, good in 17.5% and unacceptable in 10.6% of cases. Patients age < 40 years, the absence of comorbidities and duration of intervention < 180 minutes significantly favoured acceptable functional outcome. On the other hand, poor quality of fracture reduction and the development of early post-operative complications were significantly associated with poor functional outcome.

Table VI: Factor associated with development of ISNP

Retractor Used	ISNP	No ISNP	p-value	RR
Hohmann	9(52.9)	8(47.1)	< 0.001	43.9 (4.9 – 396)
Sciatic nerve	0(0)	24(100)		/
Superficial self retaining	0(0)	16(100)		/

Table V: Nine (9) months clinical and radiographic follow-up outcome following surgery via the K-L approach (N = 57)

Outcome at 9 months	Frequency	Percentage
Sequelae of Iatrogenic SNP	7	12.3
Avascular necrosis	1	1.8
Osteoarthritis	2	3.5
Heterotopic ossification	5	8.8
Loss of reduction/Debricollage	3	5.3
Conversion to THA	0	0
Death	1	1.8
Satisfactory	45	78.9

SNP = Sciatic Nerve Palsy, THA = Total Hip Arthroplasty

## DISCUSSION

### Indications of the Kocher-Langenbeck approach:

The Kocher-Langenbeck surgical approach was used as the only approach in 57/65 (87.7%) and combined with some other classical acetabular approaches in 3/65 (4.6%). This approach has also been used in the majority of cases as shown by Liebergall et al. and Hassan Rihimi et al. [12,13],

in 30/60 and 20/67 cases respectively. Our major indications of the K-L approach included: posterior wall fractures (38.6%), posterior wall + transverse fractures (36.8%), transverse fractures (10.5%), posterior column fractures (5.3%), posterior wall + posterior column fractures (5.3%), T-shape fractures (3.5%). The K-L approach was also used in combination with other approaches for both column fractures (2/65) and in anterior

column + posterior hemi-transverse fractures (1/65).

### **The K-L surgical procedure:**

Definitive fixation of fractures was achieved at a mean time between injury and surgery of 11 days (varying from 2 to 32 days). This was higher than the mean time of 4.7 days (1-40 days) in the study by Kreder et al. in Canada<sup>[14]</sup>. This difference in timing could be due to the many hurdles (financial and technical) to osteosynthesis on our setting. The most used patients positional was the prone position in 84 % of cases, on ordinary operating tables without fluoroscopic control, under general anaesthesia + oro-tracheal intubation or spinal anaesthesia.

### **Quality of fracture reduction and fixation:**

According to Matta's criteria, fracture reduction was anatomic in 80.7%, imperfect in 15.8 % and poor in 3.5%. These findings were better than the 69.7 % of anatomic reduction obtained by Liebergall et al.<sup>[12]</sup>. Our findings were similar to the 79.5 % congruent reduction obtained by Rahimi et al.<sup>[13]</sup> and the 75.5% anatomic reduction obtained by Gansslen et al.<sup>[15]</sup>. Matta for his part in 1986, had a 90% anatomic reduction<sup>[16]</sup>. This difference could be as a result of the fact that, at that time, Matta considered acceptable reduction as displacement of 3mm or less, but it was later modified to  $\leq 2$  mm, the criteria we used in our assessment of fracture reduction.

Factors that significantly favoured anatomic reduction included a surgery waiting time of 8 to 4 days after injury ( $p = 0.001$ ); RR 20.7 (95 % CI 2.4 – 176.7). Initially non-displaced fractures ( $\leq 2$ mm), also favoured anatomic fracture reduction as compared to initial displacement  $> 2$ mm, although the difference was not statistically significant ( $p=0.09$ ). Poor reduction was significantly associated to timing for surgery  $> 21$  days ( $p = 0.002$ ). This is because after 21 days, there is already the presence of soft callus which may render reduction difficult.

### **Immediate and early post-operative complications:**

About 26% (15/57) of patients developed immediate or early post-operative complications. This

was similar to the 22 % complication rate noticed by Cavalcante and colleagues<sup>[8]</sup>.

The most significant early post-operative complications following the K-L approach are shown on table III.

In general, the lowest complication rates were associated with timing of surgery between 8-14 days,  $p = 0.038$  and highest rates when timing was  $> 21$  days,  $p = 0.07$ ; RR 4.7 (95% CI 0.9 – 24.4)

Factors associated with the development of iatrogenic sciatic nerve palsy (ISNP):

ISNP following acetabular fractures have been described as an occurrence with varying frequencies. Fassler et al. and Bogdan et al. had ISNP incidences of 21.4 % and 19% respectively<sup>[17,18]</sup>, findings similar to the 19.3 % rate of ISNP in our study. Other authors however have reported smaller incidences of ISPN<sup>[6,15,19-21]</sup>. Overall, iatrogenic nerve palsy after acetabular surgery occurs in 1% to 18% of cases<sup>[19]</sup>. The most common iatrogenic injury involves the peroneal division of the sciatic nerve. This was exactly our experience.

Looking at the anatomic presentation of the sciatic nerve, the most frequent presentation was the nerve being anterior to the piriformis muscle (44/57), peroneal branch through the piriformis (10/57), peroneal branch posterior to piriformis (2/57) and peroneal and tibial branches through piriformis (1/57). These findings were similar to the described disposition of the sciatic nerve in literature<sup>[22,23]</sup>. One patient out of the 2 with peroneal branch posterior to the piriformis (50%) suffered an iatrogenic sciatic nerve palsy, and 20.5% of those with the nerve anterior to the piriformis presented with palsy. These number were however too small to be conclusive.

The levering of Hohmann retractors in the greater and lesser sciatic notches was significantly associated with the development of iatrogenic sciatic nerve palsy,  $p<0.001$ ; RR 43.9 (95 % CI 4.9-396), compared with the use of sciatic nerve retractor or superficial self-retaining retractors. Several important steps such as keeping the hip extended and the knee flexed have been shown to minimized traction neurapraxia.

Excessive retraction posteriorly with the hip in flexion should be avoided as it causes tension and direct compression force on the sciatic nerve. Proper retractor positioning and instrumentation remain key in preventing this complication [24].

### **Other early complications:**

We also had higher rates of SSI (12.3%) unlike authors like Anizar et al. who had 6.7%, Kreder et al. who reported 6.7% and Zhu et al. who had about 3 % of SSI [10,14,20]. Our higher observed rates could be as a result of a relatively prolonged duration of surgery. Our findings were similar to the 12.6 % infection rate noticed by Cavalcante [8]. We did not however, record any cases of thromboembolic disease, same as in the study by Khan et al. [9], or early post-operative mortality compared to the 4.3% mortality identified by Jindal and collaborators [21] following acetabular fracture surgery.

### **Thromboembolic and Heterotopic ossification prevention:**

There was systematic thromboembolic prophylaxis for all our adult patients. Only 6/57 patients received systematic NSAIDS (Ibuprofen) for heterotopic ossification (HO) prevention. Other HO prevention methods like gluteus minimus debridement, radiotherapy or combination of NSAIDS and radiotherapy which have been shown to be better than Indomethacin alone [25], were not used in our setting.

Nine (9) months clinical, radiographic outcomes At 9 months follow-up after surgery, the clinical and radiographic outcome showed a 79% satisfactory outcome and 21% had unsatisfactory clinical and radiographic outcomes (Table V). In literature, complication rates have been described as follows: ISNP 5%, HO up to 7%, AVN 3 - 5%, post-traumatic OA 17% [26]. HO is a well-known complication associated with acetabular fracture fixation. In his study, Letournel [4] reported an overall HO rate of 24%, with clinically significant HO occurring in 10% of patients undergoing surgery with the Kocher-Langenbeck approach. As far as HO is concerned, only 6 of our 57 patients received a regular preventive method (NSAIDS). Only 66% of them did not

developed HO compared to the 94% of the vast majority who did not receive any particular HO prevention measure, although the difference was not statistically significant. This lack of association between HO prevention and development of HO has also been highlighted by Kreder et al. [14]. This may be because of the very small number of patients placed on this preventive measure. The indications for the use of HO prophylaxis in patients undergoing surgery with the Kocher-Langenbeck approach are, however, controversial [16]. Two randomized controlled trials showed no benefit associated with the prophylactic use of Indomethacin to prevent HO in patients undergoing surgery with the Kocher-Langenbeck approach [27,28]. In addition, the use of Indomethacin has been linked to non-union of posterior wall and long bone fractures as well as adverse gastroenterologic effects [29], possible explanation to the low routine prevention of HO in our study. Patient reported outcome according to the LiSat-11 questionnaire showed that 94.7% of the patients were grossly satisfied and only 5.3% were not satisfied. Lal et al. also showed that more than 80% of patients were satisfied with their results of acetabular surgery [30].

Functional outcome according to the Modified Merle d'Aubigne-Postel (MAP) score at 9 months was excellent in 71.9%, good in 17.5 % and these two categories were judged acceptable. These excellent findings were similar to results obtained by Matta et al. (76%) [16,31] and De Almeida et al. [32]. The score was not-acceptable in 10.6% of cases. Our findings were also similar to those of Giannoudis et al. in their metanalysis where they obtained 79.4 % acceptable results according to the MAP score [33]. These findings were however better than the 66% excellent outcome reported by Anizar et al. [10].

### **CONCLUSION**

The Kocher-Langenbeck (K-L) surgical approach is the most used approach in the surgical management of acetabular fractures and its main indications are posterior wall and transverse + posterior wall fractures, which are the two most common acetabular fracture patterns. In our setting, this approach yields anatomic

reduction in over 80% of cases and fixation method is mainly by reconstruction plating in buttress mode. Iatrogenic sciatic nerve palsy (ISNP) is the most significant early post-operative complication following the K-L approach. The levering of Hohmann retractors in the sciatic notches is the major risk factor for developing ISNP, compared to the use of sciatic nerve retractors. The 9-month functional outcome following surgery is excellent in 72% and unacceptable in 10.6%. Factors such as poor fracture reduction and development of early post-operative complications are significantly associated with poor outcomes. Surgeons should therefore continue to improve their surgical techniques, especially on the amelioration of instrumentation, in the management of these complex entity in traumatology.

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## ABBREVIATIONS

K-L:Kocher-Langenbeck, MAP: Merle d'Aubigne and Postel, ISNP: Iatrogenic Sciatic Nerve Palsy

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