Standard Approaches to the Acetabulum Part 1: Kocher-Langenbeck Approach

Standardní přístupy k acetabulu. Část 1: Kocherův-Langenbeckův přístup

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INTRODUCTION

Historically, standard approaches for surgical treatment of displaced acetabular fractures were the Kocher-Langenbeck approach, the ilioinguinal approach and the extended iliofemoral approach (12). Presently, several modifications of these approaches are accepted alternatives, especially anterior modifications based on the intrapelvic approach described by Hirvensalo (8).

Single access approaches allowing visualization of one acetabular column are the posterior Kocher-Langenbeck approach and the anterior ilioinguinal approach (12) and the use of a single approach is favoured (9, 24).

For more complex situations, in the 80s and 90s extended approaches (extended iliofemoral approach according to Letournel (12), its modification to Reinert (19) (Baltimore approach), and the Triradiate approach according to Mears (14)) were introduced. These approaches are presently rarely choosen due to the extensive soft tissue dissection and higher complication rates (28). Alternatively, the combination of an anterior and posterior standard approach was recommended (7, 21, 22) having the disadvantage of longer operating time and blood loss and showed no superior results compared to a single approach.

The meta-analysis by Giannoudis et al. stated that 48,7% of patients were treated using the Kocher-Langenbeck approach, followed by 21,9% ilioinguinal approaches and 12,4% extended approaches (6). More recent data from the years 2005-2007, showed that anterior approaches are now predominantly used according to a higher number of acetabular fractures with anterior column involvement. Overall, more than 40% of all patients with acetabular fractures are still approached via the Kocher-Langenbeck approach (18). Therefore, the Kocher-Langenbeck approach is still a "working horse" in approaching displaced acetabular fractures.

The Kocher-Langenbeck approach consists of two parts. In 1874 von Langenbeck described a longitudinal incision starting from above the greater sciatic notch to the greater trochanter, dissecting the gluteal muscles for treating hip joint infections (11). Theodor Kocher in 1911 described a curved incision starting from the posterior-inferior corner of the greater trochanter, running across the postero-superior tip of the greater trochanter passing oblique in line with the fibres of the gluteus maximus muscle in direction to the posterior superior iliac spine (10).

The aim of the present analysis is the detailed anatomical analysis of this standard approach, focusing on fracture indication, positioning of the patient, exposure, dissection, reduction techniques of special fracture types, approach modifications/extensions, complications and approach-specific results.

Indications

Acetabular fractures with major fracture components of the posterior column and wall and fractures with a transverse component are the main types of fractures, where the Kocher-Langenbeck approach can be applied:

- isolated fractures of the posterior wall,
- isolated fractures of the posterior column,
- associated fractures of the posterior wall and column,
- fractures with additional posterior wall fragment(s) (tranverse + posterior wall, T + posterior wall, both column + posterior wall),
- both column fractures with multifragmentary posterior column involvement,
- certain pure transverse and T-type fractures.

Contra-indications using the Kocher-Langenbeck approach

According to the presented indications this approach cannot be used in fractures with predominant anterior column/wall pathology. Therefore, the following fracture types are considered contraindications:

- isolated anterior wall fractures,
- isolated anterior column fractures,
- associated fractures with multifragmentary anterior column fractures,
- certain acetabular fracture with a transverse fracture component.

Exposure

The classical Kocher-Langenbeck approach allows direct visualization of the entire posterior column and wall and part of the supraacetabular region. Additionally, part of the inner surface of the true pelvis (quadrilateral surface) can be palpated through the greater sciatic foramen.

Additional surgical hip dislocation via bigastric trochanteric osteotomy allows a near total exposure of the acetabular roof and near total direct visualization of the articular surface (4, 23, 25), (see below).

Positioning

The Kocher-Langenbeck approach can be performed both in the prone position, usually on a fracture table, and in the lateral decubitus position (Fig. 1a) on a radiolucent table that allows all oblique views of the pelvis and acetabulum.

Advantages of prone positions on a traction table are, that the position of the femoral head is somehow reduced due to gravity and 90° of knee flexion places the sciatic nerve away from tension. Additionally, in fractures with a transverse component digital access to the quadrilateral plate is supposed to be easier achieved compared to the lateral position and interfearance by excessive abdominal pressure is avoided. The main disadvantage is, that an unscrubbed assistant is required for intraoperative manipulation of the table and hip position.

In the standard lateral position an easier mobilization of the entire leg is possible. The reported possible disadvantages are, that the femoral head leads the fracture in a displaced position due to gravity, often requiring lateral traction of the femoral head and neck by using a Schanz screw and a potential risk of sciatic nerve damage due to a not fully extension of the hip joint together with only a slight flexion of the knee.

In two comparable analyses, no advantages or disadvantages could be identified regrading quality of reduction (3, 17). The prone position lead to a higher rate of postoperative infections and revision surgeries and due to longer positioning times a potential risk of nosocomial infection was proposed (17).

We prefer the standard lateral position, as we believe that the main advantage is allowing a plan B to perform a surgical dislocation of the hip in selected fractures, which is impossible in the prone position.

Skin incision

The skin incision in the fully extended hip joint starts just anterior to the posterior superior iliac spine in direction to the greater trochanter and then along the axis of the femur ending at the transition of the proximal/middle third of the thigh (Fig. 1a). The incision line is therefore a curved incision with anterior convexity. For surgical dislocation of the hip according to Ganz, no change of this incision is necessary. When performing the skin incision in 45° hip flexion, amore straight incision is possible.

Superficial dissection

After dissecting the subcutaneous tissue in line with the skin incision, the iliotibial tract and the fascia of the gluteus maximus muscle is identified and splitted in line with the skin incision (Fig. 1b). Whereas the lateral thigh fascia is sharply incised, a blunt digital splitting of gluteus maximus fascia is recommended. At the distal wound, the trendon of the glutaeus maximus muscle is often visible.

Deep dissection

The first step during deep dissection is the identification of the short external rotator muscles (piriformis, gemellus superior et inferior, obturatorius externus et internus, quadratus femoris muscles) and the course of the sciatic nerve.

The trochanteric area is often covered by parts of the trochanteric bursae. Already an area of hematoma is visible within this bursa and a partial bursectomy has to be performed.

In a first step the quadratus femoris muscle is easily identified at the lower wound area, as its muscles fibers typically run perpendicular to the axis of the femoral shaft (Fig. 1c). By palpating the muscle belly, the sciatic nerve can be identified or even visualized (Fig. 1d), as in this area normally no significant hematoma formation is present. During further dissection the course of the sciatic nerve must always be known but a complete mobilization/dissection of the nerve is not recommended.

The most relevant step is now to identify the superior border of the quadratus femoris muscle. The terminal branch of the medial circumflex femoral artery (MCFA) must be identified. Its terminal anastomosis to anterior

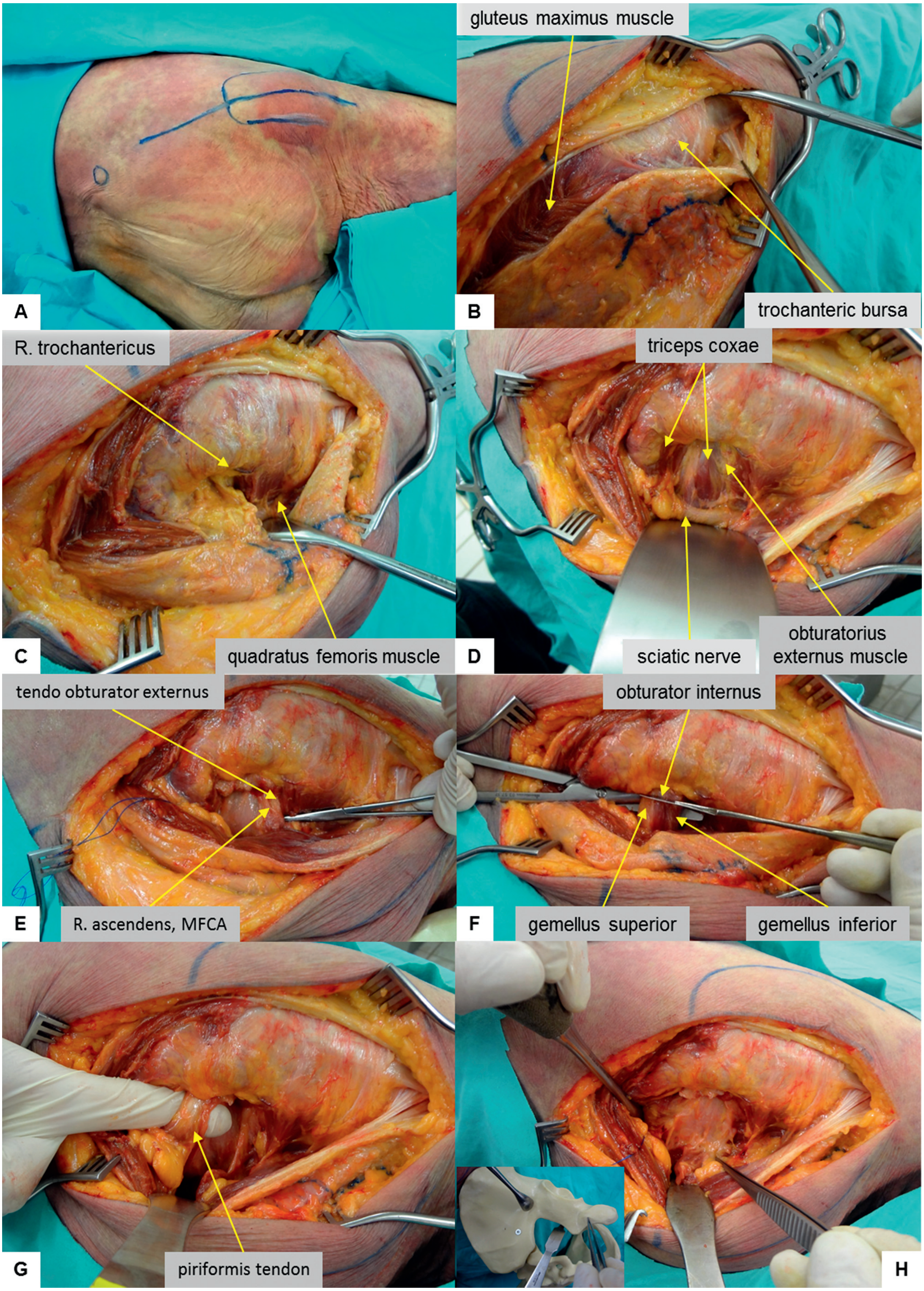

Fig. 1 Dissection Kocher-Langenbeck approach (details: see text).

arterial vessels, the R. trochantericus is almost always visable (4, 5) and can be identified in the interval between the distal triceps coxae and the quadratus femoris muscle running to the greater trochanter tip (Fig. 1c). The bottom of the forementioned interval is formed by the tendon of the obturatorius internus tendon on which the deep branch of the MCFA runs towards the capsular insertion of the femoral head-neck junction (Fig. 1e).

The third step is the identification of the piriformis tendon and the musculo-tendinous triceps coxae (Fig. 1d). After subtendinous and submuscular mobilization about 1cm away from their insertions a sharp transection is perfomed (Fig. 1f) with blunt mobilization of these muscles from the underlying capsule in direction to the posterior border of the posterior column. An anatomical landmark can often be prepared, where the oburatorius internus tendon enters the true pelvis just superior to the sciatic spine. Here, often a bursa is present and a Hohman retractor can be inserted to protect the sciatic nerve together with the muscle bellies of the triceps coxae. Care has to be taken during this procedure not to violate the deep branch of the MCFA at the upper margin of the quadratus femoris muscle, as it is crucial for the femoral head vascularity. Thereafter, the piriformis muscle/tendon is dissected comparably (Fig. 1g). The complete posterior column and wall is now visible (Fig. 1h).

If required, a capsulotomy is performed and the fracture is visualized. The acetabular labrium should be protected. It should be ensured that the hip is positioned in extension while the is flexed for releasing tension to the sciatic nerve (1).

Depending on the fracture type, in a fourth step an extended dissection can be performed to the superior dome area of the acetabulum. In this area, the glutaeus medius and minimus muscle have to be bluntly dissected from the superior capsule and the supraacetabular bone an can be retracted by inserting a blunt Hohman retractor into the bone (Fig. 1h). Avoidance of damaging these muscles can lead to a reduced rate of heterotopic ossifications.

Modifications/enlargement

Ganz and Siebenrock described a safe surgical hip dislocation technique based on the trochanteric flip osteotomy described by Mercati (15) as an enlargement of this approach to the superior, intraarticular and anterior region of the acetabulum (4, 23, 25). This enlargement can be performed via the Kocher-Langenbeck approach or, depending on the fracture type, with the Gibson approach, while protecting the short external rotator muscles (13).

Thus, the articular surface can completely be visualized and the supraacetabular region can be better exposed.

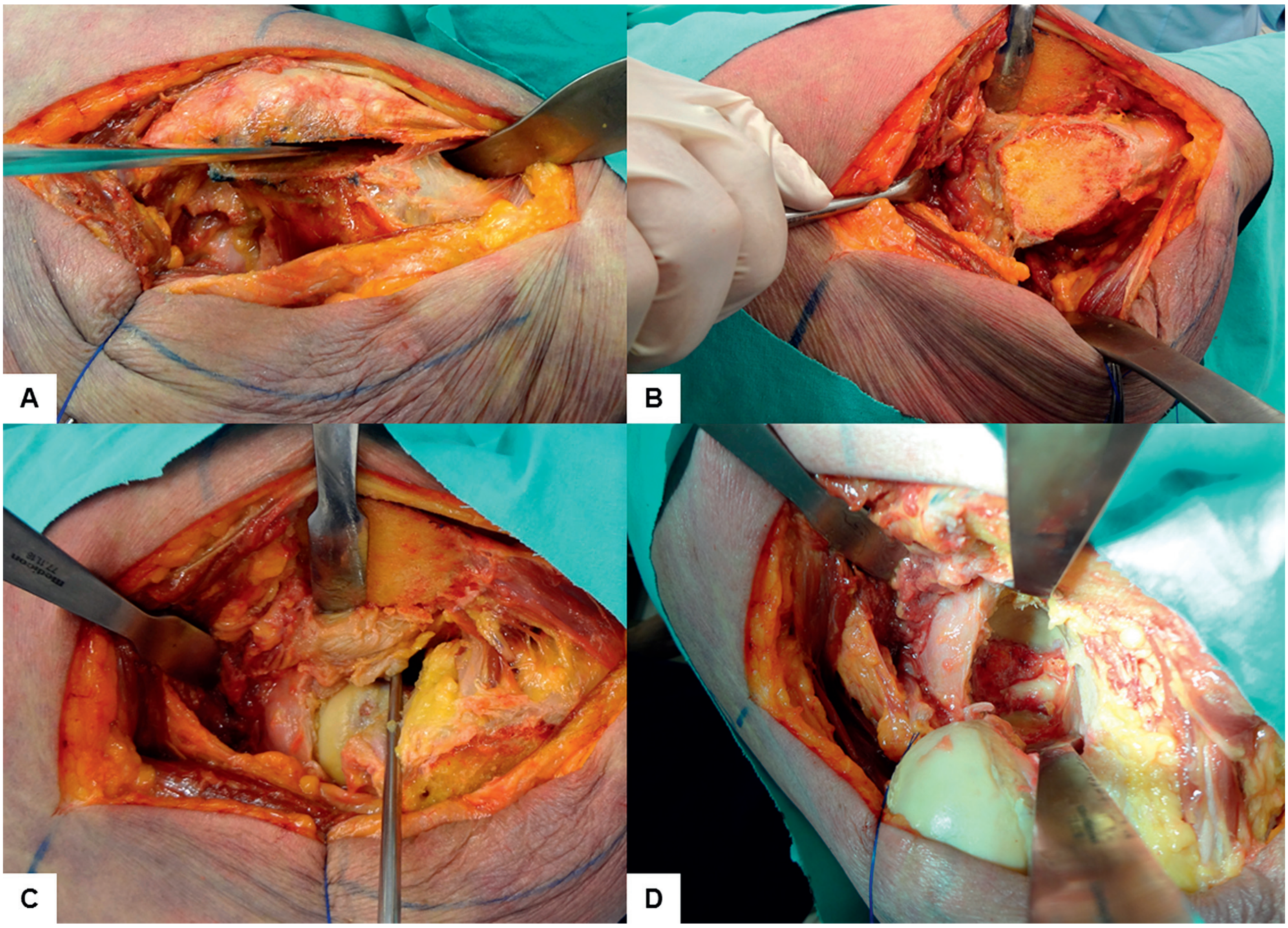

Fig. 2. Dissection Kocher-Langenbeck approach with surgical dislocation of the hip (details: see text).

Furthermore fractures with a transverse component can more safely be fixed with an anterior column screw under direct visualization of the reduction and the implant position.

The approach of the surgical hip dislocation is identical with the Kocher-Langenbeck approach regarding preparation of the greater trochanter, the short external rotators, the quadratus femoris muscle and the sciatic nerve.

Originally, a straight trochanteric osteotomy was favored with a trochanteric bone chip (flip fragment) of maximum 1,5cm width starting just anterior to the origin of the vastus lateralis muscle and posterior to the fibers of the gluteus medius muscle (Fig 2a). For easier and better reattachment, today a Z-shaped osteotomy is favored. It has to be noted, that only few fibers of the piriformis tendon should be attached to the trochanteric flip fragment.

The vastus lateralis is mobilized with the gluteus medius and the flip fragment anteriorly for visulalization of the anterior and superior capsule (Fig. 2b). Now the interval between the upper border of the piriformis muscle and dorsal-caudal edge of the gluteus minimus muscle has to be identified. Depending on the fracture type, the tendons of the triceps coxae and the piriformis muscle can remain intact. In acetabular fractures dissection of these tendons is often necessary for better exposure of the posterior column. Mobilization of the gluteus minimus from the capsule allows a sufficient superior acetabular view. The anastomosis between the deep branch of the circumflex artery medial femoral and the inferior gluteal artery at the lower border of the piriformis must be protected (5).

By flexion and external rotation of the hip joint, the anterior capsule can be sufficiently exposed (4). Capsular incision starts anterior at the femoral shaft along the femoral neck axis and in posterior direction parallel to the acetabular labrum.

With external rotation of the hip, the femoral head can be dislocated posteriorly and the leg is positioned anteriorly in a prepared sterile bag (Fig. 2c). Inserting of appropriate retractors at the anterior and posterior rim of the acetabulum and into the obturator foramen allows complete visualization of the articular surface (Fig. 2d). Additional posterior traction of the femoral head and neck with a hook retractor visualization.

RESULTS

Approach-related results are rare in the literature, and often have the disadvantage of an inhomogeneous patient and acetabular fracture population. According to the Kocher-Langenbeck approach some early results are reported by Letournel (12) and some recent results exists (20).

Detailed results on Kocher-Langenbeck-related complications are given by Letournel (12). He observed eight and six violations of superior gluteal artery and vein, respectively and 20 postoperative hematoma (4.3%). An iatrogenic sciatic nerve injury was seen in 9.9% and the rate of deep infection was reported to be 3.2%.

Rommens analyzed 60 consecutive patients with fractures of the posterior wall, which were approached by the Kocher-Langenbeck approach (20). The rate of postoperative sciatic nerve damage was 8.3%. A deep hematoma was observed in 3.3%, and an infection occurred in one patient (1.7%). An anatomic reduction could be achieved in 96.7%.

Briffa et al. reported on results in 71 patients with different acetabular fractures treated via the Kocher-Langenbeck approach (2). The rate of exact anatomical reconstructions (0–1 mm) was 70.4%, 14.1% were reconstructed almost anatomically (2–3 mm) and 15.5% had a non-anatomical reconstruction.

Tannast et al., reported on the data of Matta in 352 patients using the Kocher-Langenbeck approach (27). The average blood loss was 800 ml and the average operating time was 150 minutes. 82% of these fractures had anatomical reconstruction, 15% almost anatomical (2–3 mm) and 3% non-anatomical reconstruction of their joint.

Current analyses compared the results using the Kocher-Langenbeck approach in the lateral decubitus position and prone position (3, 17).

Osteosynthesis of 66 transverse fractures showed 5 complications (7.6%) (3). There were 4 infections (6.1%) and a temporary sciatic nerve lesion (1.5%). There was no difference in terms of positioning. Anatomical reconstructions were observed in 60% in the prone position in contrast to 40% in the lateral position. Duration of surgery and the estimated blood loss was comparable with approximately 260 minutes and 580 ml, respectively.

In contrast, another study showed no effect of positioning on the rate of anatomical reconstructions (17). Though, in the prone position infections and the need of secondary surgical interventions was more frequent.

Results after using the technique of surgical hip dislocation and the bigastric trochanteric osteotomy are increasingly reported.

In an analysis of 18 patients with different fracture types, the overall operation time was 216 minutes at an estimated blood loss of 900 ml is reported (16). In 77.8% an anatomical joint reconstruction was achieved, and in no case a non-anatomical reconstruction.

Results of the Bernese group in 60 patients with different fracture types showed a surgical time of 204 minutes at an estimated blood loss of 1556 ml (26). 4 complications have been described (6.7%): one iatrogenic superior gluteal nerve damage, one loss of reduction, one fracture non-union and one non-union of trochanteric osteotomy. An anatomic joint reconstruction was achieved in 92.6% and in the remaining patients anatomical satisfactory results with a maximum displacement of 3 mm was observed.

Results focusing on specific fracture types (T-fractures, pure transverse fractures and transverse fractures with an additional fracture of the posterior wall) showed minor anatomical reconstructions rates with 65% anatomical, 16% almost anatomical (2–3 mm) and 19% non-anatomical reconstructions (13) The average operative time was 150 minutes at the mean blood loss was 1334 ml.

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