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Results of Surgical Treatment of Acetabular Fractures Using Kocher-Langenbeck Approach

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Rezumat

Rezultatele tratamentului chirurgical în fracturile acetabulare operate prin abordul Kocher-Langenbeck

Scopul acestui studiu este de a evalua rezultatele tratamentului chirurgical în fracturile acetabulare operate prin abordul posterior Kocher-Langenbeck
Metodă: O serie de 42 de cazuri consecutive au fost tratate prin această metodă în 4 ani. Vârsta medie a pacienților a fost de 41 de ani. Fracturile au fost clasificate astfel: perete posterior – 9 cazuri, coloană posterioară – 3 cazuri, transversă – 11 cazuri, coloană posterioară și perete posterior – 4 cazuri, transversă și perete posterior – 10 cazuri, în formă de T – 5 cazuri.
Rezultate: Calitatea reducerii a fost apreciată pe radiografiile postoperatorii folosind criteriile lui Matta. Reducerea a fost anatomică în 25 cazuri (59.5%), imperfectă în 11 cazuri (26.2%) și insuficientă în 6 cazuri (14.3%). Complicațiile neurologice au apărut la 3 pacienți iar un pacient a prezentat o infecție acută. Rezultatele clinice (pentru 38 de pacienți) au fost excelente în 9 cazuri (23.7%), bune în 23 cazuri (60.5%), acceptabile în 4 cazuri (10.5%) și slabe în 2 cazuri (5.3%). Osificările heterotopice au fost înregistrate în 14 cazuri și necroza capului femural în 2 cazuri. A existat o corelație semnificativă statistic (r = 0,68 – coeficientul Pearson) între calitatea reducerii și rezultatele clinice.
Concluzii: În pofida numărului relativ mare de complicații, tratamentul chirurgical al fracturilor deplasate este net superior celui conservator unde rata complicațiilor este mult mai mare.

Cuvinte cheie: fracturi acetabulare, abord Kocher-Langenbeck

Abstract

Aim of the study: To evaluate the results of acetabular fractures surgically treated using posterior Kocher-Langenbeck approach for internal fixation.
Methods: A series of 42 consecutive cases treated during a 4 year period was analysed. The mean age of the patients was 41 years. According to the Letournel classification 9 posterior wall fractures, 3 posterior column fractures, 11 transverse fractures, 4 posterior column and posterior wall fractures, 10 transverse and posterior wall fractures and 5 T-shaped fractures were noted
Results: Quality of reduction based on Matta's criteria shows anatomical reduction in 25 cases (59.5%), imperfect in 11 cases (26.2%) and poor in 6 cases (14.3%). Neurological injury represented by peroneal nerve palsies occurred in 3 patients (7.1%). Acute infection was noted in one case (2.4%). Clinical results (for 38 patients) was excellent in 9 cases (23.7%), good in 23 cases (60.5%), fair in 4 cases (10.5%) and poor in 2 cases (5.3%). There was a statistically significant correlation between quality of reduction and clinical results with r = 0.68 (Pearson coefficient). Heterotopic ossifications were recorded in 14 cases and osteonecrosis of the femoral head was recorded in 2 cases.
Conclusions: Despite the relatively large number of complications, surgery treatment for acetabular fractures offers better results than conservative treatment, in which the complication rate is much higher.

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Key words: acetabular fractures, Kocher-Langenbeck approach

Introduction

Acetabular fractures are a challenge due to the difficulty of their treatment and high complication rate. Over the last years, a high incidence of these fractures was observed, on account of the rising number of traffic accidents. This type of fracture is characteristic to young patients or adults that suffer from high energy trauma. The mediocre results of the conservative treatment of complex acetabular fractures led to a different approach when dealing with this type of fracture. Modern approaches favor surgical treatment with an aim to reduce the rate of complications. However, surgical treatment of acetabular fractures is not widespread as the surgical technique is laborious and the expertise of a skilful operating team is much needed, all of these while bearing in mind that this type of fracture is not very frequent.

The aim of this study is to present the results of the surgical treatment of acetabular fractures using the posterior Kocher-Langenbeck approach.

Table 1. *Associates injuries of the patients with acetabular fractures*

Associated injuries	No. of cases
Head	8
Chest	6
Spine	3
Upper limb fractures	2
Lower limb fractures	5
Genitourinary	4
Abdominal	3
Nerve	5
No associated injuries	6

Table 2. *Type of the fractures according to Letournel classification*

Type of fracture	No. of cases (%)
Posterior wall fracture	9 (21.4%)
Posterior column fracture	3 (7.1%)
Transverse fracture	11 (26.2%)
Posterior column and posterior wall fracture	4 (9.5%)
Transverse and posterior wall	10 (23.8%)
T-shaped	5 (11.9%)
Total	42

Material and Method

Over a period of four years (2008-2011), 42 patients were surgically treated by open reduction followed by internal fixation (ORIF), using the posterior Kocher-Langenbeck (KL) approach. In the above mentioned period of time, 65 acetabular fractures were diagnosed, 6 of which were surgically treated using an anterior approach (due to fracture pattern). Another 4 fractures were treated by primary total arthroplasty (elderly patients) and 13 fractures were dealt with by a conservative method.

The lot of study consists of the 42 patients with ORIF by KL approach. Patients were more frequently male (M/F = 29/13) with a mean age of 41 years (range 26-71 years). Patients were assessed both clinically and by radiographic imaging. Associated injuries were recorded (*Table 1*). Associated upper limb fractures consist of one case with proximal humeral fracture combined with supra-inter condylar humeral fracture and one case with metacarpal fracture. Associated lower limb fractures were 2 supracondylar fractures, 2 patellar fractures and one tibial plafond fracture. Only 6 of the 42 patients had no associated injuries.

Radiographic investigation consisted in all cases of an antero – posterior (AP) view of the pelvis, iliac and obturatory views. The X-ray analysis was made using the system of observations proposed by Brandser (1) and this lead to the correct classification of most acetabular fractures. In all cases a CT scan was performed and in 38 cases 3D reconstruction was available.

27 patients had a posterior dislocation of the femoral head, visible on the first radiography. Reduction was performed in the first 6 hours since presentation. Complementary radiography (iliac and obturatory views) and CT scan were performed after the reduction. If the reduction was unstable supracondylar traction was use. The fractures were classified according to the Letournel (2) classification (*Table 2*).

The indication for ORIF was represented by acetabular fractures with a displacement of more than 3 mm in patients in which surgical intervention was deemed as carrying no unacceptable risks. All surgeries were performed using the posterior Kocher-Langenbeck approach. Patients were operated on in a prone position in 41 of the cases and in a lateral position in one case, in which severe thoracic lesions made the prone position unsuitable. The surgical intervention consisted in open reduction followed by internal fixation with plate and screws in 39 cases (*Fig. 1*) and screws alone in 3 cases (*Fig. 2*). Antimicrobial prophylaxis was continued for 3 days postoperatively using a third-generation cephalosporin; for thrombosis prophylaxis a low-molecular weight heparin was used and continued for 35 days postoperatively. Patients received a 6 week regimen of non-steroidal antiinflammatory medication for the prevention of heterotopic ossification. At 48 hours in the postoperative period patients were allowed to sit. Walking with partial weight-bearing was allowed after 2 weeks and walking with full weight-bearing was allowed 8-10 weeks after the operation. The follow-up was 1-4 years.

Results

The mean injury-to-operation interval was 6 days (range, 3 to 19 days). The mean length of hospital stay was 16 days (range, 11 to 74 days).

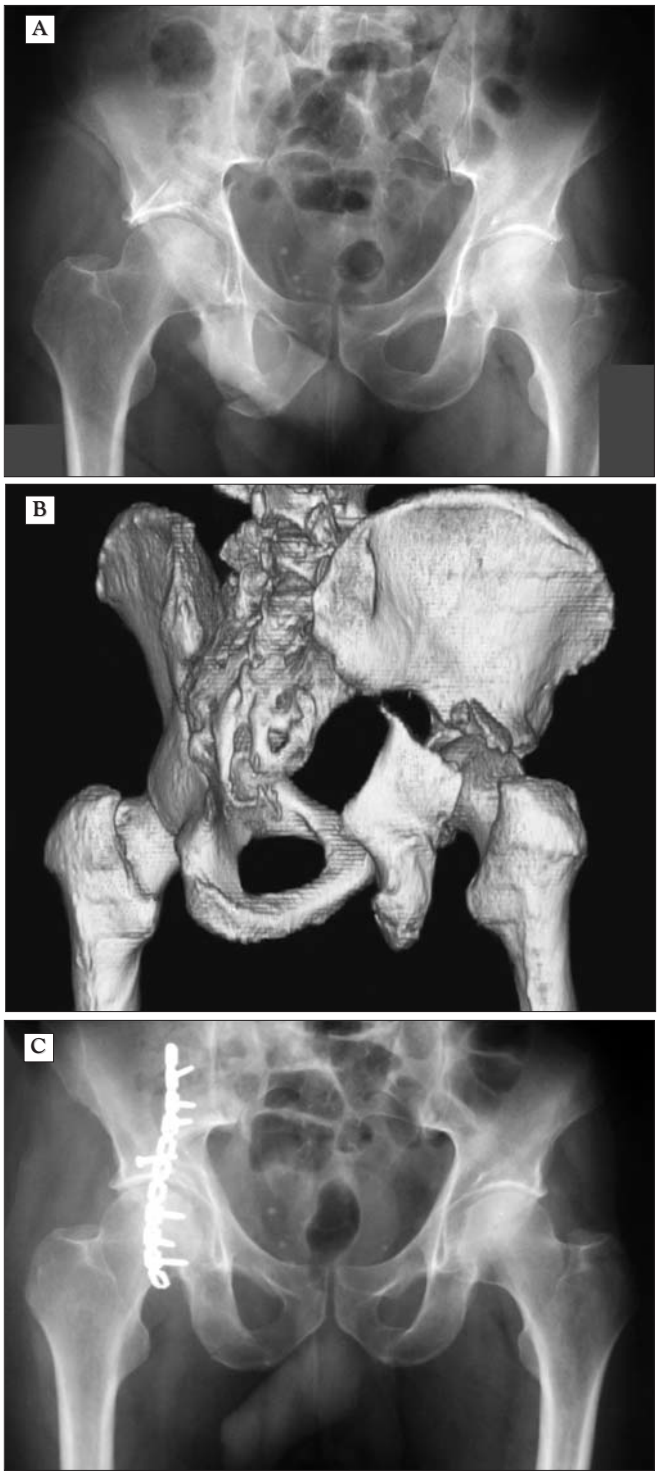


Figure 1. *Pelvis radiography (**A**) showing transverse acetabular fracture in a 42 year-old-man; 3D reconstruction CT (**B**); postoperative radiography (**C**) showing anatomical reduction and fixation with plates and screws*

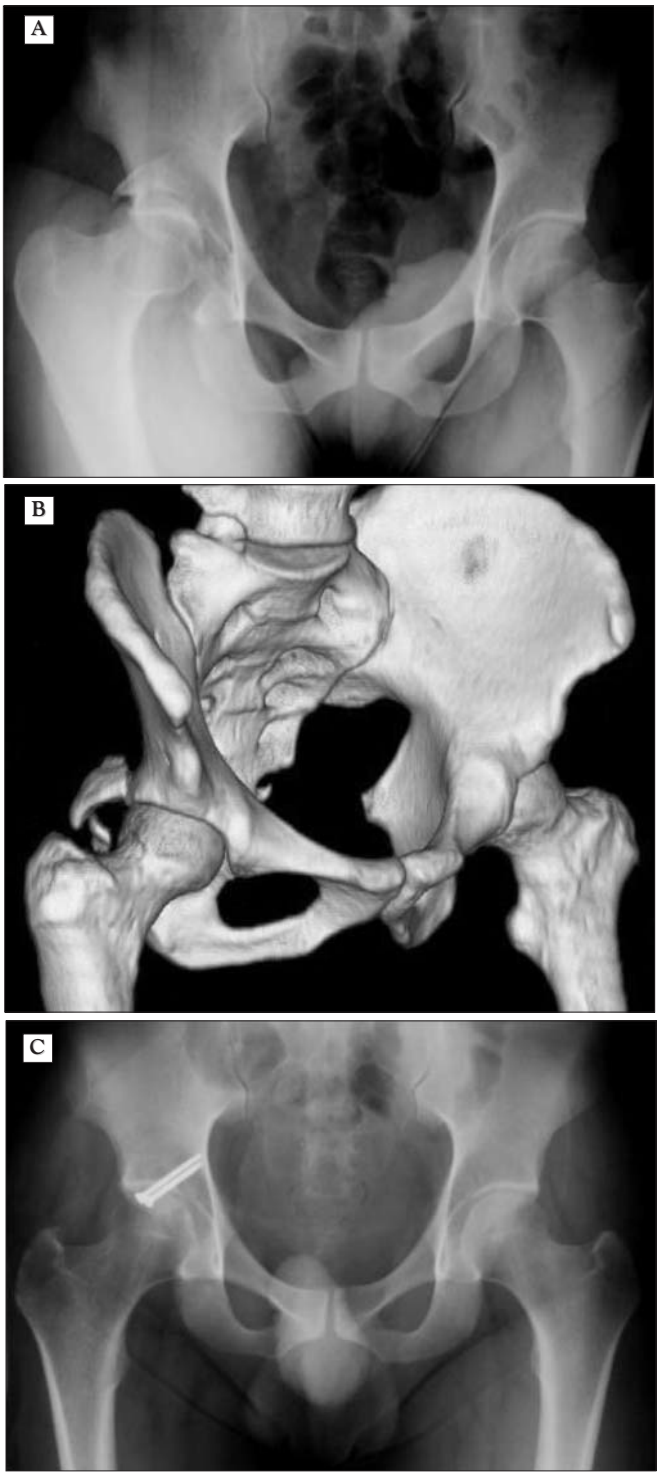


Figure 2. *Pelvis radiography (**A**) showing posterior wall fracture in a 31 year-old-man; 3D reconstruction CT (**B**); post-operative radiography (**C**) showing anatomical reduction and fixation with 2 screws*

We recorded the intraoperative complications that consisted of 2 cases (4.8%) of unusual bleeding and 3 cases (7.1%) of joint penetration by the screws. The unusual bleeding, requiring intraoperative blood transfusion (in both cases), appeared at the level of the greater sciatic notch when performing the reduction and was due to the lesion of the superior gluteal artery. In one of the cases the assistance of a vascular surgeon was required. Joint penetration with screws during the surgery was noted in 3 cases at the moment of plate fixation. In all 3 cases, the screws were immediately



Figure 3. *Poor reduction according to Matta's criteria in a 53 year-old-man*



Figure 4. *Postoperative dislocation of the femoral head in a 28 year-old-man*

repositioned with the aid of intraoperative fluoroscopy.

Quality of reduction was appreciated by X-ray imaging in the second or third day postoperatively using Matta's criteria (3). The reduction was considered anatomical in 25 cases (59.5%), imperfect in 11 cases (26.2%) and poor (*Fig. 3*) in 6 cases (14.3%). Among the 6 poor results one case showed incongruence of the hip and dislocation of the femoral head (*Fig. 4*). The dislocation of the femoral head was not obvious intraoperatively because the fluoroscopic controls were made while traction was applied to the femur.

The 6 cases with poor reduction were among the first 15 in the series, possibly due to the long learning curve related to the surgical treatment of this type of fractures.

Neurological injury represented by peroneal-nerve palsies occurred in 3 patients (7.1%). Other 4 patients had neurological injuries recorded prior to surgery. All the palsies remitted in maximum 3 months postoperatively and after 1 year no patient had any neurological sequelae.

Acute infection was noted in one case (2.4%). In this case on the 10th postoperative day, after the identification of the microbial agent from the wound secretion, a surgical toilet of the wound was performed. The subsequent evolution of the patient was favourable, but she required a total of 74 days of hospital stay. Deep venous thrombosis occured in 7 cases (16.7%), but there were no pulmonary thromboembolisms recorded.

Clinical results one year after the surgery were assessed using the system of Merle d'Aubigné and Postel modified by Matta (3) for 38 patients. The main elements followed were pain, walking and range of hip motion. According to this evaluation scale we recorded excellent results in 9 cases (23.7%), good results in 23 cases (60.5%), fair results in 4 cases (10.5%) and poor results in 2 cases (5.3%). The poor results were noted in one patient who had a fracture displacement of 10 mm postoperatively, and in one patient with posterior dislocation of the femoral head. There was a statistically significant correlation between quality of reduction and clinical results with $r = 0.68$ (Pearson coefficient). Heterotopic ossifications (HO) were recorded from AP plane radiography of the pelvis one year after surgery for 38 patients and classified according to Brooker (4). According to this classification, class I has islands of bone within the soft tissues, class II has bone spurs from the pelvis or proximal end of the femur, class III has bone spurs from the pelvis and/or proximal end of the femur, reducing the space between opposing bone surfaces to less than 1 cm and class IV shows bone ankylosis of the hip. We recorded 8 cases (21%) of class I HO and 6 cases (15.7%) of class II HO.

Osteonecrosis of the femoral head was recorded in 2 cases (4.8%), but the follow-up period was relatively short and the number of complications is likely to increase with the study period. One of the patients with poor results was treated by total hip arthroplasty (18 months after initial surgery), while the other one did not accept arthroplasty as he did not consider the symptomatology important enough to justify a surgical intervention.

Discussion

Understanding the mechanism of injury in this type of fractures represents the key element in early diagnosis, identifying associated lesions and increased quality in the care of trauma patients (5). Also, using a quantitative method for measuring trauma severity - a trauma scores - is a very important tools in trauma patients management, prognosis assessment and research (6).

The KL approach is one of the most frequently used techniques for the treatment of acetabular fractures, being preffered as frequently as in 70 – 92% of the cases in some studies (7,8,9). Zhu (10) assesed the quality of the reduction, functional results and complications in 116 patients who had suffered from acetabular fractures and had been treated by the KL technique; 5 of the fractures were T-type fractures, 53 were transverse and posterior wall fractures, 18 were posterior column and posterior wall fractures, 4 were fractures involving both columns and one patient presented a fracture of the anterior column with posterior hemitransverse involvment.

The results of the follow-up were identified as being, in 39 cases – anatomical reductions, in other 31 cases – satisfactory reductions, whereas poor reduction of the fracture was found in 11 cases. The clinical results were excellent and good in 62 cases (76.5%), which led him to conclude that associated fractures of the posterior wall and the posterior column, most of the associated transverse and posterior wall fractures, some of the T-type fractures and the fractures of both columns can be treated solely by a KL approach, thus achieving excellent reduction and satisfactory functional results.

Different evaluation systems, such as the ones sugested by Letournel (2), Merle d'Aubigné modifficated by Matta (3) - used by the authors - were employed for the evaluation of functional results after treatment of acetabular fractures using the KL approach.

A series of factors that could influence postoperative results were taken into account; these factors are related either to the patient, or the fracture, or possible postoperative complications. El-khadrawe (11), in a study performed on 55 patients were the KL approach was used in 54.5% of the cases and the KL approach associated to the anterior approach was used in 18.2% of the cases, found good - excellent results in 38 cases and poor results in 17 cases. Anatomical reduction and/or restoration of perfect congruence in the hip joint were associated with better outcome. Additionally, he noted that bad results were encountered in the presence of associated fractures of the pelvic ring, fractures of the posterior wall, articular surface comminution and presence of intraarticular fragments. He concluded that the most important factors that influence postoperative evolution are related, on the one hand, to the personality of the fracture – determined by the degree of damage to the articular cartilage, and not by the type of fracture - and, on the other hand, to the ability of the surgeon to obtain an anatomical reduction and avoid possible postoperative complications.

An anatomical reduction (less than 1 mm displacement) is the objective all surgeons aim for. If this is not obtained, posttraumatic arthrosis occurs after a certain time with its subsequent implications. In the studies conducted by Moed (8) and Borrelli (12), arthrosis appeared in 14-27% of the patients who had bad to good X-ray evaluation scores; in these cases a close correlation was identified between the clinical and radiological score ($\kappa = 0.75$, $p < 0.001$).

The most important risk factors associated with bad functional results are advanced age, unsatisfactory reduction of the fracture, fracture characteristics, injury of the femoral head and delaying the treatment. Moed (8), in a study conducted on 100 patients, of whom 94 were followed up for 5 years, managed to obtain an anatomical reduction in 97 patients, imperfect reduction being noted in the other 3 cases. The clinical results at the end of the study were assessed as excellent in 55 patients, very good in 25 cases, good in 9 cases, acceptable in one case and poor in 10 cases. The author observed a close correlation between the clinical results and the final radiological evaluation grade and identified a series of risk factors which could determine the subsequent evolution of these patients: age over 55 years, intraarticular comminution, delay of over 12 hours in the reduction of an associated hip dislocation and osteonecrosis.

Mears (13), on a cohort of 424 patients who suffered from acetabular fractures, obtained anatomical reduction in 282 (67%) cases, imperfect reduction in 90 (21%) cases, unsatisfactory reduction in 39 (9%) cases, and secondary congruence in 13 (3%) fractures of both columns; quality of reduction was significantly worse with advancing age. Regarding clinical outcome, the Harris score was excellent in 179 (42%) of the cases, good in 126 (30%) of the cases, acceptable in 54 (13%) of the cases and poor in 65 (15%) cases; good or excellent clinical results were noted in 249 out of the 282 patients (89%) who benefitted from an anatomical reduction. Among the 119 patients with acceptable and poor results, 92 patients (77%) had unfavourable prognostic factors –extended impaction, articular abrasion, fractures of the femoral head/neck or obesity. The author noted that anatomical stable reduction was characteristic to younger patients, whereas in elderly patients reductions were frequently altered; he proposed the idea of re-evaluating the role of non-surgical treatment, open limited reduction or primary hip arthroplasty as therapeutic alternatives in older patients.

Regarding the delay between fracture and surgical intervention, Zhang (14), in a study performed on 17 patients in whom surgical intervention was performed after a delay ranging between 6 hours to 11 days after the fracture, obtained an anatomical reduction in 9 cases, satisfactory reduction in 5 cases and unsatisfactory reduction in 3 cases (using Matta's criteria for evaluation). Clinical results were excellent in 4 cases, good in 9 cases, acceptable in 3 cases and poor in one case, using the Merle d'Aubigné and Postel criteria, with a good and excellent rate of 76.5%. The author concluded that, in the case of transverse and posterior wall acetabular fractures, it is important to minimize the delay of surgical treatment by the KL approach.

Among the postoperative complications, the incidence of iatrogenic sciatic nerve palsy is between 2% and 16% (15,16)

and is encountered more frequently when using an ilioinguinal approach as observed by Letournel (17). He noted an incidence of the palsy of 10% when using a KL approach; however, in 25% of the cases the palsy had been already present before the intervention, but a faulty neurological exam in the preoperative period had failed to identify it. In the same study, deep infections were identified in 1.5% of the cases and intraoperative bleeding is frequently associated with iatrogenic injury to the superior gluteal artery, its incidence being of 5%. Exposure of the artery and its ligation is frequently necessary but, unfortunately, it they may be accompanied by iatrogenic injuries to the superior gluteal nerve.

Associated injuries, often accompanying pelvic or acetabular fractures may be discovered sometimes later (18) and may be a cause for delay of the surgery (19).

Heterotopic ossification appears to be the most frequent complication of the surgical treatment of acetabular fractures. The incidence of this complication was noted in less than 10% of the cases in which the KL approach was used in the study of Deo (20), but it complicated 53% of the cases in the study of Borrelli (12). Another important complication, related more to fracture type than to surgical technique, is deep venous thrombosis, noted in 34% of the cases, and its most important consequence – pulmonary thromboembolism (2%) (21). These complications are, however, deemed by most authors as being less important in the patients' clinical evolution.

One other subject of concern is patient positioning: prone versus lateral position. In 2009, Negrin (22) published a study of 27 cases of transverse acetabular fractures which were followed up 9 months in the postoperative period. The author found a significant higher rate of unsatisfactory reduction and significant higher rates of posttraumatic arthrosis when patients were operated on using lateral positioning. In 2010 the same author (23), published a study of 104 cases - 50 operated on in the prone position and 54 in the lateral position and observed that the group of patients operated on in the prone position presented a significantly higher rate of infection and reintervention; he concluded that, regarding the positioning of the patient, there was no superior alternative, noting, however, that the more complex fractures were operated on in the prone position.

With regard to the evaluation of the surgical technique and results in acetabular fractures Ochs (24) revised epidemiological, clinical and radiological data for 1266 patients with acetabular fractures from three distinct periods: 1991-1993 (n=359), 1998-2000 (n=503), and 2005-2006 (n=404). Over the period of time 1991 - 2006, the rate of surgical treatment went up to 77% at a national level. An anatomical reduction (a displacement of less than 1mm) was obtained in 551 cases (64%). The quality of the reduction was not correlated with the period of time elapsed before surgical treatment, and was lower in simple fractures and in patients with isolated acetabular fractures when compared to polytraumatized patients. Most importantly, quality of reduction has not improved in time, in spite of the rising frequency of surgical treatment. The KL approach was the preferred approach in the 90s in almost three quarters of the interventions. Despite introducing variation in the choice of approaches and the higher rates of surgical treatment in the last 15 years, no improvement in the quality of acetabular fracture reduction was noted. Therefore, considering the rarity and complexity of acetabular fractures, continuing education, preferably by the side of experienced surgeons, on-going scientific research and clinical results' evaluation are needed for ensuring optimal care.

Conclusions

Surgical treatment of acetabular fractures requires the presence of a skilful and experienced surgical team, the learning curve being relatively slow. The aim of the surgical intervention is the anatomical reduction of the fracture, which is the first most important determinant of clinical results. Despite the relatively high number of complications, the surgical treatment of acetabular fractures is superior to the conservative one, which is accompanied by a much higher rate of complications.

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