



## The complications after open hip dislocation in hip surgery

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**Our purpose is to evaluate the complications of open hip dislocation, which is used as a helpful technique in hip surgery. We have retrospectively reviewed 45 hips of 44 cases who applied open hip dislocation with various indications in our institute between the years 2006-2013. There were 27 males and 17 females whose mean age was 31,9 (range, 11-58) years with mean follow-up time of 56,9 months (range, 13-106). The number of cases with at least one complication related to open hip dislocation was 27. Within our series 14 hips have developed only 1 complication, 1 hip have 2, 10 hips have 3 and 2 hips have 4 different complications. Regarding Dindo-Clavien classification 17 hips were evaluated as Grade I (38%), 3 hips were Grade IIa (7%), 2 hips were Grade IIb (4%) and 5 hips were Grade III (11%). In conclusion, the absence of major complications after open hip dislocation does not make it absolutely safe. Open hip dislocations can only be indicated when trochanteric complications are considered. The patients need to be well informed on potential issues and risks.**

**Keywords :** open surgical dislocation of the hip ; complications ; dindo-clavien classification ; trochanteric nonunion ; heterotopic ossification.

### INTRODUCTION

The open surgical dislocation of the hip technique is defined and popularized by Ganz (8). They reported that medial femoral circumflex artery (MFCA), which is the main vascular supply

of the femoral head, is well preserved with this technique and thus will avoid avascular necrosis (AVN) of the femoral head (7,8). Some studies have shown several complications following open hip dislocation technique however, the most worrisome complication reported by far is the AVN of the femoral head.(14).

Several authors have evaluated open hip dislocation technique and its complications ; however, these reports are mostly considering the complications related with surgical treatment of femoroacetabular impingement (FAI) (10,13).

The purpose of this study is to evaluate the open surgical dislocation of the hip technique, regardless of the diagnosis, to determine the frequency of complications and emphasize potential complications.

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## PATIENTS AND METHODS

The data of open surgical dislocation of the hip performed in our clinic between years 2006-2013 were retrospectively reviewed. The data of 47 patients' 48 hips who had open surgical dislocation of the hip by different surgeons were achieved. 3 patients were excluded due to inadequate clinical and radiological data. 44 patients 45 hips (27 male-61%, 17 female-39%) who have at least 12 months of clinical follow-up and adequate radiological data were included in the study. This technique was applied to right hip in 31% (14) and to the left hip in 69% (31) of the patients. The number, percentage and surgical indications of open surgical dislocation of the hip performed cases are given in Table I. Postoperative 8<sup>th</sup>, 16<sup>th</sup> week and 12<sup>th</sup> month follow-up physical examinations and radiographic findings of the patients were assessed for any developing complications (heterotopic ossification (HO), pain, muscle weakness, contractures, etc.). Of these 44 cases, 27 (18 male-66,7%, 9 female-33,3%), who developed complications related to open surgical dislocation of the hip procedure, were selected and asked for a last follow-up. The patients were sub grouped and evaluated according to the developed complications.

### Surgical Technique

All patients were positioned to lateral decubitus. The femoral heads were dislocated by open surgical dislocation of the hip technique described as Ganz and the further surgery was related to the individual indication. The trochanteric osteotomy was properly fixed via screw (size 3,5 or 4,5) or K-wire fixation

as proposed by the original technique (3 screws in 3 cases, 2 screws in 40 cases and 4 K-wires in a case were used). Neurovascular examinations of lower extremities were noted at early postoperative period in patients who had general anesthesia and after post anesthesia recovery period in patients who had regional anesthesia. No routine prophylaxis was applied to prevent heterotopic ossification (HO). Low molecular weight heparin was used to prevent deep vein thrombosis in all patients except for 2 patients at 11 years. Early postoperative bedside exercises were applied to prevent extensor muscle weakness. All patients were allowed to bear weight as tolerated from the first postoperative day. Physical examination and radiographic evaluations were recorded at weeks 4 and 8 during follow-up. Those who show radiographic bone healing and no pain at surgical site with motion are allowed to full weight bearing and abductor muscle strengthening exercises.

The hip joint range of motion (ROM) of the patients at week 12 during follow-up was recorded. Patients with limited ROM were included in an intensive physical therapy program. Following 6<sup>th</sup> and 12<sup>th</sup> months follow up patients were controlled annually. During follow up patients were assessed for AVN, malunion at trochanteric osteotomy site, implant failure at trochanteric fixation, HO, surgical site and/or deep infection, trochanteric irritation findings, pain, muscle weakness and ROM by physical examination and radiographic evaluation. Additional complications were also noted.

The open surgical dislocation of the hip related complications were classified by Dindo-Clavien classification system (6). HO cases were classified by Brooker classification (4).

Table I. — The number, percentage and surgical indications of surgical dislocation applied cases.

Indications	Number of hips	(%) of hips
FAI for trimming	21	47%
AVN of the femoral head for Trapdoor technique	15	34%
Osteoid osteoma for excision	3	7%
Modified Dunn procedure	2	4%
Sequel of Perthes disease for femoral head size reduction	2	4%
Femoral head osteochondral defect for mosaic plasty	1	2%
Chondromatosis for resection	1	2%



**Fig. 1.** — Pelvis AP radiograph of a 46 years-old female patient from our series, representing Grade I HO regarding Brooker classification.

### Statistical Analysis

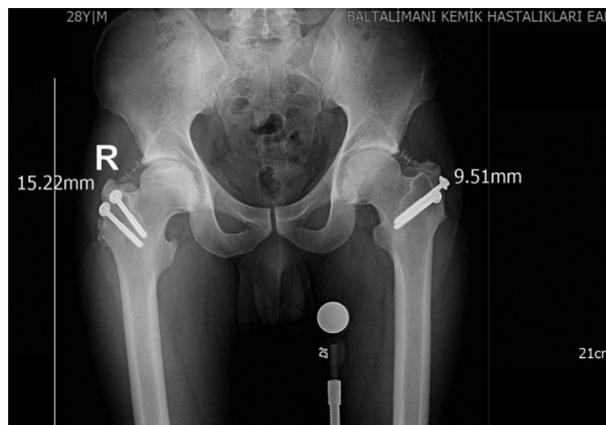
The IBM Statistical Package for Social Sciences (SPSS) 20.0 was used for all statistical analysis. Distributions of the variables were evaluated by Kolmogorov-Smirnov test. The difference between the ages was compared by independent t-test. The difference between sex distributions was evaluated by Fisher-Exact test. Statistical significance was calculated as  $p < 0.05$ .

### RESULTS

The mean age in 44 patients was 31,9 (range, 11-58). The mean follow up time was 56,9 months (13-106). Our series have shown 11 individual complications. These complications and their ratios are given in Table II.

The mean age of the 27 patients (60%) with complication was 34,2 years (range, 14-58) and 18 were male, 9 were female. No complication was detected in 18 hips (40%) of our series.

When number of complications were assessed; 14 hips had only 1 kind of complication (31%), 1



**Fig. 2.** — Late postoperative pelvis AP radiograph of a bilateral application of surgical dislocation in a 28 year-old male. Note the right hip developed Brooker Grade II HO whereas ; the left hip developed Grade III HO.

hip had 2 (2%), 10 hips had 3 (22%) and 2 hips had 4 individual complication profiles (5%).

None of the patients developed neurologic deficit related with sciatic nerve injury at early or late postoperative period. However three patients in our series developed ongoing abductor muscle weakness and found that muscle weakness has progressively became persistent. At last follow up muscle strength was found 4/5 in two cases and 3/5 in a case and positive Trendelenburg test was accompanying these conditions.

The AVN of the femoral head was detected in 1 of 30 cases (open reduction and internal fixation patient for slipped capital femoral epiphysis (SCFE)) when patients that had open surgical dislocation of the hip for AVN (Trapdoor technique) were excluded. Even though the development of AVN seems to be related with existing condition rather than applied technique, we have recorded this patients as a complication. One patient who had open surgical dislocation of the hip for Trapdoor technique developed a femoral neck fracture after eight weeks of surgery and managed by total hip prosthesis.

HO was observed in 19 hips of 18 patients (13 male-68%, 6 female-32%) during follow up, however; none of the patients showed an excision requiring limited ROM and none of the patients had clinical complaints related with HO. Regarding

Table II. — The complications of surgical dislocation and their ratios are given.

Complications	Number of hips	(%) of hips
Heterotopic ossification	19	36,5%
Pain around trochanteric region	15	28,8%
Abductor muscle weakness	3	5,7%
Trochanteric bursitis	3	5,7%
Hip contracture	3	5,7%
Trochanteric fixation failure	3	5,7%
Surgical site infection	2	3,8%
AVN of the femoral head	1	1,9%
Femoral neck fracture	1	1,9%
Trochanteric non-union	1	1,9%
Pulmonary emboli	1	1,9%



**Fig. 3.** — Pelvis AP radiograph of a 50 years-old male patient from our series, representing Grade III HO according to Brooker classification.

Brooker classification of HO at hips; 13 cases (68,6%) were evaluated as Grade I (7 male, 6 female), 5 cases (26%) were Grade II (all male) and a case was (5%) Grade III (male). Two of Grade II patients and a Grade I hip had labral repair surgery due to FAI. Another case that required labral repair was not developed HO.

Mean age of the patients who developed HO in our study was  $36,6 \pm 10,8$  years and the mean age of the ones who did not develop was  $28,6 \pm 10$  years. There was statistically significant difference between both groups ( $p = 0,016$ ), however; when gender distribution is compared no significant difference was found ( $p = 0,54$ ).

The mean time for the healing of the trochanteric osteotomy was 8,2 weeks (range 5-12 weeks). 3,5 and 4,5 (cannulated or non cannulated) screws were used for the fixation of trochanteric osteotomy. 10 hips required 3,5 mm (5 cannulated and 5 non-cannulated) screws, 35 hips required 4,5 mm (27 cannulated and 8 non-cannulated) screws. When the relation between the size of screws and HO development is considered; 3 patients (7%) that applied 3,5 mm screws and 16 patients (36%) with 4,5 mm screws have developed HO. The lesions were detected in trochanteric region and surroundings (piriform fossa) in almost all hips that developed HO (Figures 1, 2 and 3).

Non-union at trochanteric osteotomy site was detected in one patient (who had two 4,5 mm screws for fixation) and revised eventually. Trochanteric fixation failure was observed in three cases. In a case with trochanteric fixation failure (who applied three 3,5 mm screws), although a screw was found to be dislocated from fixation, revision was not required, as the fixation of remaining two screws was found sufficient. Remaining two cases (who applied 2 4,5 mm screws) required revision as both screws were found dislocated.

15 hips developed pain or tenderness at trochanteric region and from them; three cases were diagnosed as trochanteric bursitis. However none required bursa excision. 7 patients had pain only with increased activity but 8 patients had pain also at resting. The screws are extracted at 6 of 15 cases as the pain was related with screw irritation however; no decrease in pain was detected postoperatively. Regarding age; there were no significant difference between the group with trochanteric pain (mean age =  $34,53 \pm 10,2$ ) and the group without pain (mean age =  $30,67 \pm 11,3$ ). ( $p = 0,25$ ) There was also no significant difference between two groups regarding gender. ( $p = 0,34$ )

Table III. — The complication profiles, numbers and percentages of our cases according to Dindo-Clavien classification.

Dindo-Clavien Classification	Included complication profile	Number of hip	(%) of hip
I	HO and trochanteric pain, Trochanteric bursitis	17	38%
IIa	Hip contracture, Surgical site infection	3	7%
IIb	Trochanteric non-union, Pulmonary emboli	2	4%
III	Abductor muscle weakness, AVN of the femoral head Femoral neck fracture	5	11%

Two patients developed superficial surgical site infection and treated with antibiotherapy in early postoperative period.

Serious limitation of hip flexion was encountered at three patients who were operated for FAI. With intense rehabilitation at postoperative period, full range of motion (ROM) was regained.

A patient was diagnosed pulmonary emboli at postoperative second month (58 years, male) and managed without complication. The vast majority of complications were related with trochanteric osteotomy.

The complication profiles of our patients were assessed by Dindo-Clavien classification. Regarding Dindo-Clavien classification, 17 hips were evaluated as Grade I (38%), 3 hips were Grade IIa (7%), 2 hips were Grade IIb (4%) and 5 hips were Grade III (11%). (Table III)

Regarding age; there were moderate difference between the group with complication according to Dindo-Clavien classification (mean age= 34,88±10,8) and the group without complication (mean age = 28,6 ± 10,5). (p = 0,05) There was no significant difference between two groups regarding gender. (p = 0,5)

## DISCUSSION

The open surgical dislocation of the hip is known as a useful method in surgeries of proximal femoral and acetabular region, as it provides a good approach. According to Ganz et al., who defined and popularized this method, open surgical dislocation of the hip is defined as a low-grade controlled trauma (7).

The open surgical dislocation of the hip technique, previously, was used for cam excision or acetabular labrum repair in femoroacetabular impingement

(FAI) surgery; recently this technique can be used for management of wide range of conditions related to hip joint (synovial chondromatosis, tumor excision, management of chondral defects, slipped capital femoral epiphysis (SCFE) or related deformities, Trapdoor technique etc.) (10,12). This study is intended to evaluate the open surgical dislocation of the hip technique for various hip conditions.

The literature indicates limited number of complications related to open surgical dislocation of the hip. A wide spectrum of complications including sciatic nerve injury to DVT can be encountered; however, minute amounts of these serious complications were reported. Our study has demonstrated a wide spectrum of complications of various level of severity from HO to pulmonary emboli. Ganz et al., as the descriptor of this method, have mentioned that the most common complication in their 213 cases series was HO (79 cases, 37%). They have also reported neuropraxia of the sciatic nerve in two cases and trochanteric screw insufficiency that require revision in three cases (7).

The most comprehensive study on complications of the open surgical dislocation of the hip was the multicenter study of Sink et al. (14). In their study named ANCHOR, the authors have detected one or more complications in 16 cases with the incidence of 4,8%. The complications were classified according to Dindo-Clavien classification and they have found out that trochanteric nonunion constituted 6 of all Brooker Grade 3 complications. Overall, trochanteric nonunion ratio was found to be 1,8%. Remaining complications in the series were DVT, surface or deep infection, transient sciatic neuropraxia and delayed union of trochanteric osteotomy respectively. The authors have also indicated that all Dido-Clavien Grade 1 complications were Brooker Grade 1 or 2 HO with male predominance (7,8%

male, 2,6% female). Similarly, in our series HO was predominant in male patients (13/19).

In a level III systematic review of Botser et al. the results of conventional, arthroscopic and combined surgical techniques were compared (3). The disadvantages of conventional surgery were reported as major intervention, soft tissue injury, osteotomy related risks, higher blood loss ratio, requirement of Lig. Teres resection and need of longer rehabilitation. They have also stated that the overall complication ratio was 9,2% in conventional surgery group and the most common complication of this group was related to trochanteric osteotomy (5,5%). The pain in trochanteric region was the main reason of revision in conventional surgery (3). Our case series included 15 cases with trochanteric regional pain and screw extraction was performed 6 cases. Authors have reported that, even though the conventional surgery seems advantageous, it is not perfect method (3).

Beaule have also considered the complications around trochanteric region (1). The authors have detected 9 persistent bursitis cases in 37 hips and have extracted all the screws. They have also reported that a case was re-operated at third week due to failure of trochanteric fixation and a case required resection of HO (Brooker Grade 4) at 10<sup>th</sup> month (1). None of the HO cases in our study group required excision.

To our knowledge the literature does not include a classification system that identify complications related to orthopaedic surgical interventions. Orthopaedic surgical complications were rather defined as major or minor. Ross et al. have classified the open surgical dislocation of the hip related complications as major, moderate and minor complications (13). The authors have defined major complications as AVN of the femoral head, neuropraxia, trochanteric nonunion and symptomatic HO. The major complication ratios varied 0% to 6% between the 6 studies, which they have reviewed. In their study, moderate complications were defined as implant related symptoms, which may or may not require extraction. They have also reported that moderate complications were found to have no effect on results of the reviewed cases whereas; asymptomatic or minor HO and other

systemic complications (fewer, urinary system disease, infection etc.) were categorized as minor complications. Regarding complication ratios in our study, major complications constituted 13% (pulmonary emboli, AVN, femoral neck fracture, abductor muscle weakness etc.).

One may ask whether the trochanteric osteotomy is the soft belly for the open surgical dislocation of the hip technique. Beck et al. have evaluated pre- and postoperative pain at trochanteric region and groin in 50 open surgical dislocation of the hip cases (2). They have reported that 8 cases (16%) had pain preoperatively, only when leaning on their effected sites, 23 cases at postoperative first year (46%) had pain at trochanteric region. They have also stated that of these 23 cases 9 had pain only when leaning on their effected sites, 3 cases had pain only with activity and 11 cases experienced difficulties in leaning on the affected sites due to trochanteric tenderness. They have also indicated that 9 patients had saddleback deformity, which is a cosmetic problem, around trochanteric region. 15 hips developed pain and/or tenderness at trochanteric region and of them; three cases were diagnosed as trochanteric bursitis. None of the patients have developed additional cosmetic problems in our study.

Minimally invasive, mini-open or combined arthroscopic techniques have been developed to prevent trochanteric osteotomy complications particularly in surgical management of FAI. Laude et al. have indicated that by their combined Heuter mini invasive technique and arthroscopic intervention, they have prevented femoral head circulation and avoided trochanteric complications, as in open surgical dislocation of the hip (9). Chiron et al. similarly, have evaluated the disadvantages of open surgical dislocation of the hip and reported 2,2 year results of 118 cases who were operated by minimally invasive anterolateral incision without surgical dislocations (5). The authors have concluded that the complication rates were relatively high (6,8%) but much lower than encountered in open surgical dislocation of the hip technique. They have also found that the most common cause of complication was hematoma and in accordance with the literature, HO was the most common complication.

The main limitation of this study was the variability of indications of this particular surgical technique, which may also affect the resultant complications. The surgical dislocations in our study were not operated by a single surgeon, which may cause bias in the results. The classification of the complications can be variable as the degree of complications may progress (eg. HO, contractures) or regress (eg. pain, muscle weakness) by the time.

The open surgical dislocation of the hip is known as a safe and reliable technique that is supported by strong data, which indicates minimal, or no disruption of femoral head circulation (7,11,14). However, occurrences of numerous minor complications may cause a controversy about its applicability. Especially the complications related to trochanteric osteotomy were thought to affect the quality of life but not the functional results.

In conclusion, the absence of major complications after the open surgical dislocation of the hip does not make it absolutely safe. The open surgical dislocation of the hip can only be indicated when trochanteric complications are considered. The patients need to be well informed on potential issues and risks. To avoid these complications, the alternative methods (minimally invasive, arthroscopic, combined surgery) can be as reliable as surgical dislocations by means of femoral head circulation and favored due to lower complication rates.

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