ORIGINAL ARTICLE

# A comparison of the minimally invasive and traditional lateral approaches for hemiarthroplasty following a femoral neck fracture: Reduced postoperative pain and fewer blood transfusions

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## ABSTRACT

**BACKGROUND:** This study aimed to investigate the effects of the minimally invasive direct lateral approach, performed using standard hip surgery instruments, on operation duration, early postoperative pain, postoperative blood loss, and hospital stay in the treatment of femoral neck fractures with hemiarthroplasty (HA), compared with the standard Hardinge direct lateral approach (referred to in this study as the conventional group, CG).

**METHODS:** We retrospectively collected clinical data from the medical records of our hospital. Inclusion criteria were a diagnosis of femoral neck fracture resulting from low-energy trauma and treatment with HA surgery. Patients were divided into two groups based on the surgical approach: the conventional group (CG) and the mini-incision group (MG). Twenty-four patients comprised the MG (case group), while 18 patients were in the CG (control group). The average wait time for surgery was 3.8 days for the MG and 3.6 days for the CG. Statistical analyses were conducted to evaluate differences in postoperative pain scores, hospital stay, postoperative blood transfusion, operation duration, hemoglobin, and hematocrit levels between the groups.

**RESULTS:** There was no significant difference in age or gender distribution between the case and control groups ($p>0.05$). The average age of the mini-incision group was 83.8 years, while the average age of the CG was 86.9 years. In both groups, the fracture types were equally distributed between Garden type III and IV. However, the visual analog scale (VAS) scores on the first and third postoperative days were significantly lower in the case group than in the CG ($p<0.05$). Patients in the MG required significantly fewer postoperative blood transfusions compared to the control group. Hospitalization duration, as well as hemoglobin and hematocrit levels both preoperatively and at discharge, were comparable between the groups.

**CONCLUSION:** The data from this study indicate that the mini-incision technique is an effective and reliable method for treating femoral neck fractures. Compared with the conventional group, the minimally invasive direct lateral approach for femoral neck fractures significantly reduces early postoperative pain, results in less blood loss, offers better cosmetic outcomes, and maintains a similar length of hospital stay. Clinical studies with larger sample sizes and assessments of long-term postoperative outcomes are necessary.

**Keywords:** Case-control study; direct lateral approach; femoral neck fractures; minimally invasive surgery; postoperative pain.

**Cite this article as:** Kılıç B, Altun S, Civan M, Şentürk F, Sıvacıoğlu S, Kömür BH, et al. A comparison of the minimally invasive and traditional lateral approaches for hemiarthroplasty following a femoral neck fracture: Reduced postoperative pain and fewer blood transfusions. Ulus Travma Acil Cerrahi Derg 2025;31:1102-1108.

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Ulus Travma Acil Cerrahi Derg 2025;31(11):1102-1108 DOI: 10.14744/tjtes.2025.60464
Submitted: 17.04.2025 Revised: 09.06.2025 Accepted: 14.06.2025 Published: 03.11.2025
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## INTRODUCTION

Minimally invasive (MI) surgical methods remain highly favored by orthopedic surgeons. Several studies in the literature have compared traditional surgical techniques with MI methods in total hip arthroplasty.[1-3] These MI approaches decrease soft tissue trauma and postoperative adhesions, shorten hospital stays, and promote easier rehabilitation.[4]

In trauma surgery, hemiarthroplasty (HA) is used to treat femoral neck fractures when osteosynthesis is not feasible or suitable. Common approaches for this procedure include the direct lateral (Hardinge), anterolateral, and posterior (Moore) techniques. These conventional methods are associated with greater tissue damage, increased postoperative pain, more blood loss, and prolonged rehabilitation. The aim of this study is to evaluate the outcomes of MI surgical techniques performed using standard hip surgery instruments readily available to surgeons, rather than relying on specialized mini-incision hip surgery instruments. This study evaluates how a MI technique impacts postoperative bleeding, hospital stay duration, and early pain levels following HA. We hypothesize that this approach will result in considerably lower postoperative pain scores, shorter hospital stays, and reduced blood loss during surgery compared to the conventional lateral approach. If confirmed, these findings may significantly improve patient outcomes and reduce healthcare costs.

## MATERIALS AND METHODS

### Research Framework

This retrospective observational study was conducted in the Department of Orthopedics and Traumatology at Kanuni Sultan Suleyman Training and Research Hospital, with approval from the hospital's ethics committee (document number: KAEK/2024.09.179). It adhered to the principles of the Declaration of Helsinki and followed STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines during manuscript preparation. All data were collected and analyzed by the authors.

### Inclusion criteria were:

1. Patients diagnosed with recent femoral neck fractures (Garden type III or IV) managed with partial hip endoprosthesis by the senior author between March 2020 and August 2024.

2. Patients with a body mass index (BMI) under 30.

3. Patients older than 65 years.

4. Patients without prior orthopedic surgery on the same hip.

Exclusion criteria were:

1. Patients with incomplete medical records.

2. Patients with pathological fractures.

3. Patients who used warfarin or clopidogrel preoperatively.

4. Patients who experienced intraoperative fracture complications.

5. Patients monitored in the postoperative intensive care unit.

6. Patients who received intraoperative blood transfusions.

7. Patients with cognitive impairment or dementia.

A flow diagram detailing the patient inclusion and exclusion process is shown in Figure 1.

Patients were categorized into two groups according to the surgical method used. Those who underwent HA via the modified Hardinge approach were assigned to the conventional group (CG), whereas those treated with a mini-incision direct lateral approach were assigned to the mini-incision group (MG).

The clinical data collected from patient records included Visual Analogue Scale (VAS) scores for postoperative days 1 to 3, duration of hospital stay, number of postoperative blood transfusions, operative time (in minutes), and hemoglobin and hematocrit levels on postoperative day 3.

### Sample Size and Power Considerations

The sample size for this study was determined through a power analysis using a 5% margin of error, 80% power, and a standard effect size of 1, indicating that each group required at least 16 patients. The number of patients remaining after applying the exclusion criteria exceeded the minimum required for each group.

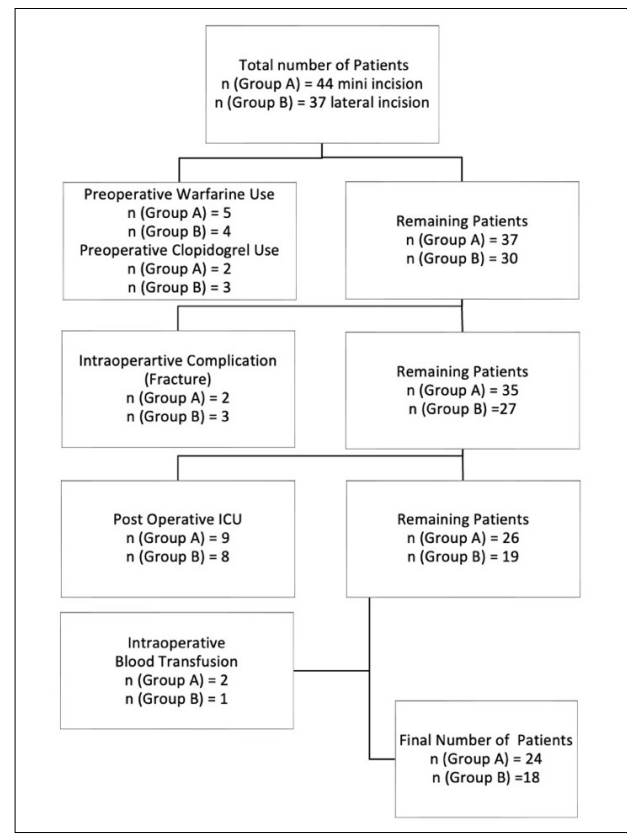



**Figure 1.** Flow diagram of patient inclusion in the study according to exclusion criteria.

### Minimally Invasive Surgical Approach Technique

The patient is placed in the standard lateral decubitus position, with the operative hip positioned in slight adduction, 45-60 degrees of flexion, and 10-20 degrees of internal rotation. Spinal anesthesia is preferred unless contraindicated. Standard hip surgery instruments are used, without employing tools designed for mini-open surgery. A skin incision is made along a longitudinal line starting from the tip of the trochanter, extending 5-7 cm proximally along the femur. The length of the incision is determined from the preoperative direct pelvic radiograph by measuring the diameter of the femoral head (Fig. 2a). The incision is located anterior to the midpoint between one-third and one-half of the transverse length of the greater trochanter on the sagittal plane. Subcutaneous tissue and fascia are dissected. Upon reaching the tensor fascia lata, the soft tissue is mobilized 1.5 cm inward from the wound margins circumferentially before proceeding to the next anatomical layer. The tensor fascia lata is split proximally and distally along the midline, parallel to the skin incision. The trochanteric bursa is resected. The anterior third of the gluteus medius muscle fibers is detached from the bone, along with the anterior half of the vastus lateralis, and shifted forward to reveal the joint capsule using a Cobb elevator. The hip capsule is incised from the saddle of the femoral neck using a traditional T-incision. Blunt Hohman retractors are

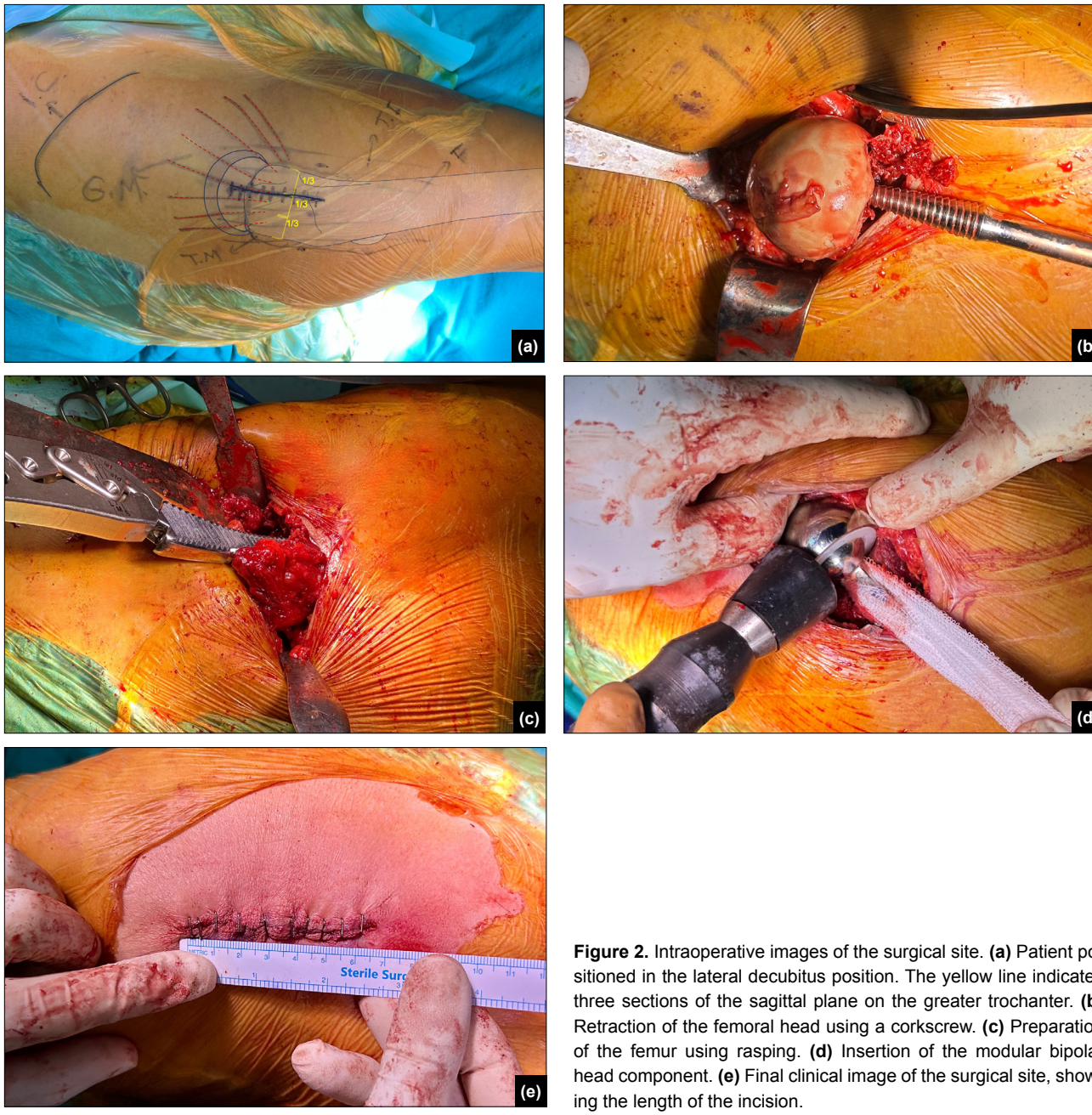



**Figure 2.** Intraoperative images of the surgical site. **(a)** Patient positioned in the lateral decubitus position. The yellow line indicates three sections of the sagittal plane on the greater trochanter. **(b)** Retraction of the femoral head using a corkscrew. **(c)** Preparation of the femur using rasping. **(d)** Insertion of the modular bipolar head component. **(e)** Final clinical image of the surgical site, showing the length of the incision.

**Table 1.** Comparison of demographics and variables between groups

| | Mini-Incision (n=24) | | Conventional (n=18) | | | |
|---|---|---|---|---|---|---|
| | Mean±SD/n (%) | Median | Mean±SD/n (%) | Median | p | |
| Patient age | 83.8±86.5 | 9.8 | 86.9±88.5 | 9.1 | 0.296 | t |
| Gender | | | | | | |
| Female | 11 | 45.8% | 9 | 50.0% | 0.789 | $X^2$ |
| Male | 13 | 54.2% | 9 | 50.0% | | |
| VAS Score | | | | | | |
| Postoperative day 1 | 6.3±6.0 | 1.0 | 7.2±7.0 | 0.9 | 0.006 | m |
| Postoperative day 2 | 4.8±5.0 | 1.0 | 5.2±5.0 | 0.8 | 0.238 | m |
| Postoperative day 3 | 2.7±2.0 | 1.0 | 4.0±4.0 | 1.1 | 0.000 | m |
| Postoperative hospitalization (days) | 3.3±3.0 | 0.8 | 3.0±3.0 | 0.6 | 0.247 | m |
| More than 3 days of hospitalization | | | | | | |
| (-) | 23 | 95.8% | 17 | 94.4% | 1.000 | $X^2$ |
| (+) | 1 | 4.2% | 1 | 5.6% | | |
| HGB g/dL | | | | | | |
| Preoperative | 10.3±10.2 | 1.5 | 10.0±9.7 | 1.5 | 0.437 | m |
| Discharge | 10.3±10.2 | 0.9 | 10.0±9.8 | 1.0 | 0.252 | t |
| HCT % | | | | | | |
| Preoperative | 31.3±30.1 | 3.7 | 30.3±29.2 | 3.0 | 0.401 | m |
| Discharge | 31.5±30.9 | 1.7 | 30.6±30.3 | 1.7 | 0.154 | m |
| Postoperative blood transfusion (units) | 1.4±1.0 | 1.2 | 2.7±3.0 | 1.2 | 0.003 | m |
| Operation duration (minutes) | 58.0±57.0 | 7.0 | 59.3±59.0 | 5.1 | 0.511 | t |

[t]Independent Samples t-test; mMann-Whitney U test; $X^2$ Chi-square test (Fisher's test).

placed anteriorly and posteriorly around the femoral neck. The femoral head is extracted using a corkscrew, followed by femoral neck osteotomy with an oscillating saw, irrigation, and placement of a sponge (Fig. 2b). The lower extremity is then repositioned in a figure-four position within a sterile pocket. Retractors are placed on the lesser trochanter, behind the greater trochanter, and posterosuperiorly to elevate the proximal femur. Standard rasping is performed, and the proximal femur is prepared to the appropriate size (Fig. 2c). Following trial reduction, the ranges of motion are: flexion (100°-120°), extension (5°-10°), internal rotation (30°-40°), and external rotation (30°-40°). Limb movements are then assessed. The trial implants are replaced with the definitive femoral stem and modular bipolar head component, and stability is checked again (Fig. 2d). Finally, the capsule is sutured, the anterior musculotendinous flap is reattached, and the tensor fascia lata, subcutaneous tissue, and skin are sutured (Fig. 2e).

### Early Postoperative Care

At our orthopedic clinic, daily VAS scores are recorded for all patients after arthroplasty procedures until discharge. Patients undergoing hip arthroplasty with the minimally invasive approach are mobilized on the second postoperative day, while on antiaggregant therapy and without a drain. In contrast, for those treated with the conventional direct lateral approach, the drain is removed on the first postoperative day. None of the patients treated by the senior author received tranexamic acid, either intravenously or locally. Patients are typically discharged once their hemoglobin and hematocrit levels have normalized, usually by the third postoperative day, and after they have completed their mobilization exercises.

### Statistical Analysis

Data were analyzed using IBM's Statistical Package for the Social Sciences (SPSS), version 27.0 (IBM SPSS Statistics, IBM Corporation, Chicago, IL), with statistical significance set at $p<0.05$. Descriptive statistics included the mean, standard deviation, median, minimum and maximum values, frequency, and percentage. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to evaluate variable distribution. Independent samples t-tests were applied to normally distributed quantitative variables, while Mann-Whitney U tests were used for non-normally distributed variables. A chi-square test was

used to compare qualitative data.

## RESULTS

The MG included 11 males and 13 females, aged 67-99 years, with an average age of 83.8 years. Their BMIs ranged from 18.1 to 25.4 kg/m² (mean 21.5 kg/m²), and their American Society of Anesthesiologists (ASA) scores averaged 2.3±0.4. The CG consisted of nine males and nine females, also aged 67-99 years, with an average age of 86.9 years. Their BMIs ranged from 17.1 to 29.5 kg/m² (mean 23.2 kg/m²), and their ASA scores averaged 2.7±0.3. No statistically significant differences were found between the two groups in terms of sex, age, BMI, or ASA score. The average wait time for surgery was 3.8 days for the MG and 3.6 days for the CG. No intraoperative complications occurred in either group. Wound healing after surgery was better and more aesthetically pleasing in the mini-incision group, whereas in the CG, minor drainage was noted over several days.

In comparison to the MG, the CG exhibited significantly higher VAS scores on the first and third postoperative days ($p<0.05$). Although VAS scores on the second day were also higher in the CG, the difference was not statistically significant ($p>0.05$) (Fig. 3, Table 1). Due to lower pain scores, MG patients mobilized more easily than CG patients. The mean duration of hospitalization was slightly longer in the MG (3.3 days) than in the CG (3.0 days) (Table 1). Drops in hemoglobin (HGB) and hematocrit (HCT) were smaller in the MG. The CG required significantly more postoperative blood transfusions, averaging 2.7 units, compared with 1.4 units in the MG (Fig. 4, Table 1). Although the mean operation time was slightly longer in the CG (59.3 minutes) than in the MG (58.0 minutes), the difference was not statistically significant (Table 1).

## DISCUSSION

An increasing number of studies have focused on arthroplasty surgical methods, which have gained popularity due to advancements in robotic instruments and technology.[5] Surgeons and patients alike consider incision length during orthopedic procedures.[6] In cases of femoral neck fractures, timely surgical intervention is crucial, particularly given patients' underlying medical conditions and advanced age.[7] The length of the incision is primarily associated with postoperative pain, which can influence early mobilization.[5,8]

This study found that patients undergoing mini-incision surgery experienced less postoperative pain and required fewer blood transfusions compared to those who had conventional incisions. However, there was no significant difference in operation time between the two approaches. The learning curve associated with total hip arthroplasty and HA represents a significant challenge.[9] Experienced surgeons typically prefer shorter incisions during hip arthroplasty, whereas less experienced surgeons may place greater emphasis on incision length during procedures.[10] This study provides insights into these factors influencing the surgical approach.

A study comparing patients with femoral neck fractures who underwent hemiarthroplasty using minimally invasive anterolateral and conventional anterolateral techniques found that

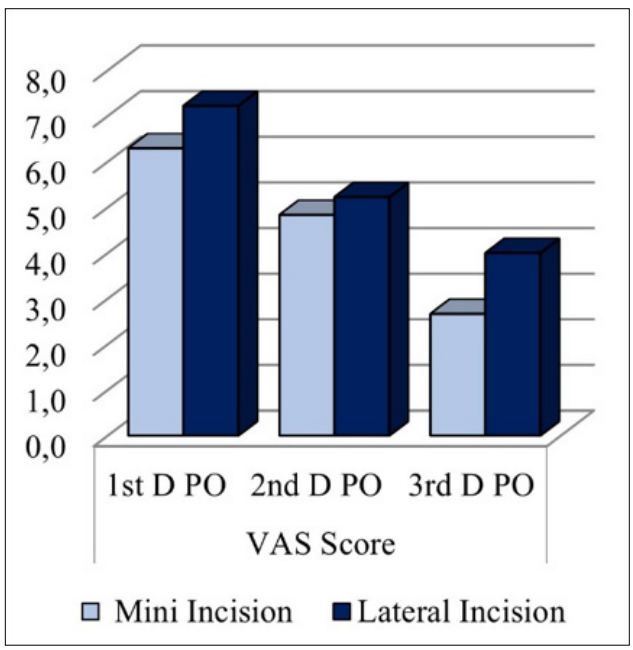



**Figure 3.** Graphical representation of Visual Analogue Scale (VAS) score parameters.

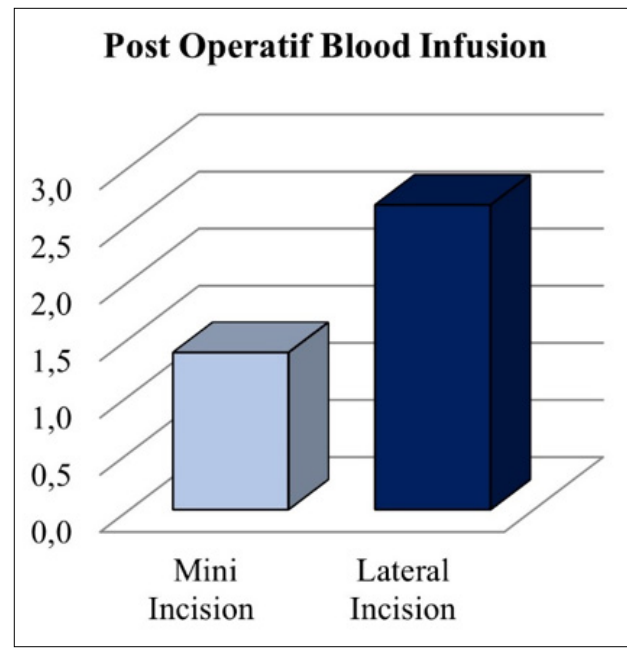



**Figure 4.** Graphical representation of postoperative blood transfusion parameters.

only the operative time was slightly shorter in the minimally invasive group, while postoperative complications and clinical outcomes remained unchanged.[11] In our study, we compared mini-incision and conventional lateral approaches, finding that postoperative pain and bleeding were reduced, and the operative time was slightly shorter for hemiarthroplasties performed with mini-incisions in patients with femoral neck fractures.

Surgeons typically use a specific set of tools to perform minimally invasive hip hemiarthroplasty for femoral neck fractures.[12,13] In our cases, minimally invasive hemiarthroplasty for femoral neck fractures was performed using a standard hip surgery set, without any specialized instruments.

The literature indicates that a minimally invasive approach does not significantly affect the length of hospital stay in hemiarthroplasty.[14] Our study also found no statistically significant difference.

Tranexamic acid is considered effective and safe for reducing transfusion rates in patients undergoing hip hemiarthroplasty. However, the optimal timing, dosage, and method of administration remain uncertain.[15,16] None of the patients who underwent mini-incision hemiarthroplasty in our study required tranexamic acid.

Previous studies suggest that the direct lateral hip approach carries a risk of heterotopic ossification.[17] Long-term follow-up is therefore recommended for cases performed with the mini-incision technique.

The literature also indicates that surgical drains are not required for elderly patients with femoral neck fractures.[18] In our mini-incision cases, drains were not used.

This study has several limitations, including a short follow-up period, lack of functional outcome data, a limited number of cases, uncertainty regarding the sustained clinical effectiveness of the surgery, and a retrospective design. Additionally, we did not obtain serum biomarkers such as C-reactive protein, erythrocyte sedimentation rate, or creatine kinase levels. The standard postoperative follow-up protocol does not include these markers unless specifically indicated. Furthermore, assessing hip scores after the follow-up period could provide greater insight into differences between groups. These limitations should be addressed in future prospective studies.

## CONCLUSION

The data from this study indicate that the mini-incision technique is an effective and reliable method for treating femoral neck fractures. Compared to the conventional group using the standard lateral approach, the minimally invasive direct lateral approach for femoral neck fractures significantly reduces postoperative pain in the early recovery period, results in less blood loss, offers better cosmetic outcomes, and maintains a similar length of hospital stay. Clinical studies with larger sample sizes and long-term postoperative outcome assessments are necessary.

**Ethics Committee Approval:** This study was approved by the Kanuni Sultan Suleyman Training and Research Hospital Ethics Committee (Date: 25.09.2024, Decision No: KAEK/2024.09.179).

**Peer-review:** Externally peer-reviewed.

**Authorship Contributions:** Concept: B.K.; Design: S.A., B.K.; Supervision: B.K.; Data collection and/or processing: F.Ş., M.C., B.H.K.; Analysis and/or interpretation: S.S., B.K., E.M., F.Ş.; Literature review: S.S., S.A., M.C., E.M.; Writing: M.C., S.A., B.K., B.H.K.; Critical review: B.K., M.C., F.Ş., S.S., E.M., S.A., B.H.K.

**Conflict of Interest:** None declared.

**Financial Disclosure:** The author declared that this study has received no financial support.

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ORİJİNAL ÇALIŞMA - *ÖZ*

## Femoral boyun kırığı sonrası hemiartroplasti için minimal invaziv ve geleneksel lateral yaklaşımların karşılaştırılması, ameliyat sonrası ağrının azaldığını ve daha az kan transfüzyonu gerektiğini göstermektedir

AMAÇ: Bu çalışmanın amacı, hemiartroplasti (HA) ile tedavi edilen femoral boyun kırıklarının tedavisinde standart kalça cerrahisi aletleri ile uygulanan minimal invaziv direkt lateral yaklaşımın, çalışmada konvansiyonel grup (CG) olarak adlandırılan standart Hardinge direkt lateral yaklaşıma kıyasla operasyon süresi, erken postoperatif ağrı, postoperatif kan kaybı ve hastanede kalış süresi üzerindeki etkilerini araştırmaktır.
GEREÇ VE YÖNTEM: Hastanemizin tıbbi kayıtlarından klinik verileri retrospektif olarak topladık. Seçilen hastaları dahil etme kriterleri; düşük enerjili travmadan kaynaklanan femoral boyun kırığı tanısı almış ve HA cerrahisi ile tedavi edilmiş olmak. Hastalar cerrahi yaklaşıma göre iki gruba ayrıldı: konvansiyonel grup (CG) ve mini kesi grubu (MG). Yirmi dört hasta MG'yi (vaka grubu) oluştururken, on sekiz hasta CG'de (kontrol grubu) yer aldı. Ameliyat için ortalama bekleme süresi MG için 3.8 gün ve CG için 3.6 gündür. İstatistiksel analizler, gruplar arasında postoperatif ağrı skorları, hastanede kalış süreleri, postoperatif kan infüzyonu, operasyon süresi, hemoglobin ve hematokrit seviyelerindeki farklılıkları değerlendirmek için yürütüldü.
BULGULAR: Çalışmamızda vaka ve kontrol grupları arasında yaş ve cinsiyet dağılımında anlamlı bir fark bulunmadı ($p>0.05$). Mini kesi grubunun ortalama yaşı 83.8 yıl iken, diğer grubun ortalama yaşı 86.9 yıldı. Her iki grupta da kırık tipleri eşit olarak Garden tip III ve IV idi. Ancak, birinci ve üçüncü postoperatif günlerdeki görsel analog skala (VAS) skorları vaka grubunda CG grubuna göre anlamlı derecede düşüktü ($p<0.05$). MG' deki hastalar kontrol grubuna kıyasla anlamlı derecede daha az postoperatif kan transfüzyonuna ihtiyaç duydu. Hastanede kalış süresi, hemoglobin ve hematokrit seviyeleri hem operasyon öncesi hem de taburculuk sırasında gruplar arasında benzerdi.
SONUÇ: Bu çalışmadan elde edilen veriler, mini kesi tekniğinin femur boynu kırıklarının tedavisinde etkili ve güvenilir bir yöntem olduğunu göstermektedir. Geleneksel grupla karşılaştırıldığında; femur boyun kırıkları için minimal invaziv direkt lateral yaklaşım, standart lateral yaklaşıma kıyasla erken iyileşme döneminde postoperatif ağrıyı önemli ölçüde azaltır, daha az kan kaybına, daha iyi kozmetik sonuçlara ve benzer bir hastanede kalış süresine yol açar. Daha büyük vaka sayılarını içeren ve uzun vadeli postoperatif sonuçları değerlendiren klinik çalışmalar gereklidir.

Anahtar sözcükler: Direkt lateral yaklaşım; femoral boyun kırıkları; minimal invaziv cerrahi; postoperatif ağrı, vaka kontrol çalışması.

Ulus Travma Acil Cerrahi Derg 2025;31(11):1102-1108 DOI: 10.14744/tjtes.2025.60464