

# Journal of Surgery and Medicine

e-ISSN: 2602-2079

## Comparison of proximal femoral nail and dynamic hip screw for treating intertrochanteric fractures

### İntertrokanterek femur kırıklı olgularda proksimal femur çivisi ile dinamik kalça vidasının karşılaştırılması

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#### Abstract

**Aim:** In this study, the use of proximal femoral nail and dynamic hip screw for treatment of intertrochanteric hip fractures were compared in terms of mortality and morbidity.

**Methods:** 131 patients who had an operation due to intertrochanteric hip fractures were evaluated demographic characteristics and surgical data (72 female, 59 male, mean age 77.85, range 65-98 years). 98 patients (74.8%) PFN method, 33 patients (25.2%) DHS method was applied. The age and gender of patients, etiology, type of anesthesia, preoperative waiting period, preoperative ASA (American Society Anesthesiologists) score calculated by anesthesia physicians, Singh index, track time, the type of fracture, complication rate, the degree of reduction, tip-apex distance, shortening the existence and mortality were investigated. The Harris Hip Score was used for functional assessment.

**Results:** The average post-operative follow-up period was 25.23 (1-66) months. The group that were applied DHS were found significantly different for reduction success ( $p<0.05$ ). Harris Hip Scoring of patients in the DHS group were found significantly better ( $p<0.05$ ). The success of the reduction in the DHS group was significantly related with the Harris HipScore ( $p<0.05$ ).

**Conclusion:** We have concluded that the preoperative waiting time has no impact on mortality, increasing age increases the systemic disease, therefore increases ASA score. So that increasing ASA score increases the mortality. Unstable intertrochanteric fractures of the femur PFNA, due to the higher success rate of reduction should be preferred. But between two methods there were no significant differences about healing time and mortality. In conclusion, surgical techniques to be used should be selected according to the fracture type and age of the patient.

**Keywords:** Femur fracture, Osteosynthesis, Mortality

#### Öz

**Amaç:** Bu çalışmada İntertrokanterek kalça kırığı tedavisinde kullanılan Proksimal femur çivisi ve dinamik kalça vidası cerrahi yöntemleri mortalite ve morbidite açısından karşılaştırıldı.

**Yöntemler:** İntertrokanterek kırık nedeniyle opere olan 131 hastanın (72 kadın, 59 erkek, ort yaş 77.85; dağılım 65-98 yıl) demografik özellikleri ve ameliyat verileri değerlendirildi. Doksan sekiz hastaya (%74,8) PFNA, otuz üç hastaya ise (%25,2) DHS uygulanmıştır. Hastaların yaş, cinsiyet, kırık olan kalça tarafı, kırık etyolojisi, anestezi tipi, preoperatif bekleme süresi, anestezi hekimince hesaplanan preop ASA (American Society Anesthesiologists) skoru, Singh indeksi, takip süresi, kırık tipi, komplikasyon oranı, redüksiyon derecesi, tip-apex mesafesi, kısalık varlığı ve kaynama düzeyi ve mortalite incelendi. Fonksiyonel değerlendirmede Harris Kalça Skoru kullanıldı.

**Bulgular:** Ameliyat sonrası ortalama takip süresi 25.23 (1-66) ay idi. Redüksiyon başarısı açısından DHS grubu lehine anlamlı fark saptanmıştır ( $p<0.05$ ). DHS grubundaki hastaların Harris Kalça Skorları istatistiksel olarak daha iyi bulundu ( $p<0.05$ ). Redüksiyon başarısı açısından DHS grubu lehine anlamlı ilişki saptandı ( $p<0.05$ ). DHS grubunda redüksiyon başarısı ile Harris Kalça Skoru doğru orantılı olacak şekilde anlamlı bulundu ( $p<0.05$ ).

**Sonuç:** Preoperatif bekleme süresinin mortalite üzerine bir etkisinin olmadığına, yaş arttıkça sistemik hastalıkların, dolayısıyla da ASA skorlarının arttığına ve ASA skorunun artmasının da mortaliteyi arttırdığı sonucuna varıldı. İnstabil intertrokanterik femur kırıklarında PFNA, redüksiyon başarısı oranlarının daha yüksek olması sebebiyle tercih edilmelidir. Ancak kaynama zamanı ve mortalite açısından belirgin bir fark saptanmadı. Hangi cerrahi yöntemin kullanılacağına hastanın yaşına ve kırık tipine göre kararlaştırılmasının daha uygun olacağına kanaat getirildi.

**Anahtar kelimeler:** Femur kırığı, Osteosentez, Mortalite

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Ethics Committee Approval: Ethics committee approval was received from Ege University Ethical Committee with number of B.30.2.EGE.0.20.05.00/OY/888/403 in 3 June, 2015.

Etik Kurul Onayı: Çalışma için Ege Üniversitesi Tıp Fakültesi Klinik Araştırmalar Etik Kurulu 03.07.2015 tarih ve B.30.2.EGE.0.20.05.00 /OY/888/403 sayılı onay alınmıştır.

Conflict of Interest: No conflict of interest was declared by the authors.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Financial Disclosure: The authors declared that this study has received no financial support.  
Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

Received / Geliş Tarihi: 30.01.2018  
Accepted / Kabul Tarihi: 06.03.2018  
Published / Yayın Tarihi: 06.03.2018

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## Introduction

Intertrochanteric femur fractures are frequent and common fractures in the elderly population. It has been reported that 90% of hip fractures are older than 65 years [1]. In the same population, when compared to other fractures, it is the first in terms of death, disability and medical costs [1,2].

Nowadays, the scientific development of living conditions in parallel with a good situation has a significant increase in the average life span. People in the advanced age group can develop osteoporosis in proportion to inactivity and inadequate nutrition. As a result, simple traumas and intertrochanteric fractures occur.

Although intertrochanteric femur fractures are associated with low energy in elderly patients, high-energy trauma in younger patients may lead to similar forms of fracture [2].

The treatment plan of patients with intertrochanteric femur fractures is made by evaluating the pre-fracture functional adequacy, life expectancy, mental status and social life in which they are present. Currently, Proximal Femur Nails (PFN) and Dynamic Hip Screws (DHS) are used for osteosynthesis for intertrochanteric fracture treatment. In this study, we retrospectively investigated the relationship between DHS and PFN surgical methods used in intertrochanteric fracture treatment, mortality and morbidity.

## Materials and methods

A total of 131 patients over 65 years of age who underwent surgery with intertrochanteric femoral fracture between March 2009 and December 2013 were evaluated retrospectively in Ege University Medical Faculty Hospital Orthopedics and Traumatology Department.

Of these 131 patients, 98 (74.8%) were treated with PFN and 33 (25.2%) with DHS.

Patients with stable or instable intertrochanteric fractures over 65 years of age were included. Patients younger than 65 years, pathologic fractures and subtrochanteric fracture patients were excluded from the study. Between the two groups; age, sex, fracture etiology, type of anesthesia, preoperative waiting period, preoperative ASA score, Singh index, follow-up period, fracture type, complication developed, shortness and union rate were investigated. Results were evaluated as excellent, good, moderate and poor according to the scoring obtained by applying the Harris Hip Score to assess hip function (Table 1).

In the preoperative radiological evaluation of patients, fractures were classified using AO classification, fracture displacement before surgery and Singh index were evaluated (Table 2).

Postoperative radiological evaluation; postoperative reduction rate, varus-valgus and anteversion-retroversion angle were determined. The measured collodiaphizer angle was compared to the nontraumatic opposite hip. Angles below 5° as anatomic reduction, angles between 5° and 10° were considered as acceptable reductions, and angulations above 10° were accepted as poor reductions [3]. The tip-apex distances were assessed by anterior-posterior and lateral radiographs as described by Baumgartner [4]. In his work, Baumgartner

evaluated the position of the lag screw within the femur head and improved the TAD (Tip-Apex Distance) concept. TAD distance is calculated in millimeters. In the post-operative radiographs, the side that is treated was compared with the other side and the amount of shortness was calculated in cm. Patients were evaluated radiologically in terms of duration of union, complication, revision and mortality.

Surgery was performed in the supine position and on the radiolucent traction table. Anesthesia was left to the choice of the anesthetist. The lateral incision was made through the large trochanteric tip that the surgeon detected with the index finger. Fixation was applied after reduction. PFNA or DHS was used for fixation. Patients receiving PFNA were mobilized with load of 20% of body weight for 15 days, 50% of body weight after 15 days and full load after 45 days. Patients with DHS were mobilized with no load for 15 days, 20% of body weight after 15 days, and full load after 45 days.

Patients were called to the clinic for remove the stitches at week 2. One-and-a-half months, 3 months, 6 months and 12 months after routine examination made with X-ray graphs.

### Statistical analysis

Statistical analysis were performed using the IBM SPSS Statistics 21.0 program (IBM SPSS Statistics for Windows, version 21.0, Armonk, NY: IBM Corp.) and the SAS 9.3 program. Values of  $p < 0.05$  were considered significant. The mean, standard deviation, median, minimum, maximum, frequency, and ratio values were used for descriptive statistics. The Mann-Whitney-U test was used for quantitative variables. Correlations between categorical variables were examined by the Pearson Chi-square test and Fisher's exact probability test. Union was estimated by multiple logistic regression.

## Results

Of these 131 patients, 98 (74.8%) were treated with PFN and 33 (25.2%) with DHS. Patients undergoing PFN were referred to as group 1, and patients with DHS as group 2. The mean age of the patients in group 1 was 78.51 (65-98) while the mean age of the patients in group 2 was 78.91 (65-91).

Of the general population, 72 (55%) were female and 59 (45%) were male. There were 58 (59.2%) female and 40 (40.8%) male patients in the group 1 and 14 (42.4%) female and 19 (57.6%) male patients in group 2. The mean follow-up time was 23.86 (1-66) months in group 1 and 29.30 (1-64) months in group 2. In the general population, 121 (92.4%) patients had simple fall, 10 (7.6%) had car accidents. Of the 98 patients in the group 1; 93 (94.9%) were simple falls, 5 (5.1%) were traffic accident and in group 2; 28 (84.8%) were simple falls, 5 (15.2%) were traffic accident. Patient's time to surgery were 5.83 (1-22) days in the general population, 5 (1-19) days in group 1 and 5 (1-22) days in group 2. In general, the distribution of fractures was 68 (51.9%) right and 63 (48.1%) left. In group 1, 56 (57.1%) right and 42 (42.9%) left side treated. In group 2, this distribution was left in 12 (36.4%) and right in 21 (63.6%). 121 patients (92.4%) were treated with spinal anesthesia, 8 (6.1%) with epidural and spinal anesthesia and 2 (1.5%) with general anesthesia. In Group 1, 91 (92.9%) were treated with spinal anesthesia, 5 (5.1%) were spinal-epidural anesthesia and 2 (2%) were general anesthesia. In Group 2, 30 patients (90.9%) were

treated with spinal anesthesia and 3 patients (9.1%) were spinal-epidural anesthesia, but no general anesthesia was applied. In group 1, 8 died in the first month (8.2%), whereas in group 2, this number was 3 (9.1%). The number of patients who died within the first 3 months was 11 (11.2%) in group 1 and 4 (12.1%) in group 2. The number of patients who died within the first 12 months was 18 (18.4%) in group 1 and 6 (18.2%) in group 2 (Table 3) ( $p>0.05$ ).

Table 1: Comparison of hip scores between groups

| Harris Score | Grup 1 (64)   | Grup 2 (25)   | Total (89)    |
|--------------|---------------|---------------|---------------|
| Excellent    | -             | 3 (%12)       | 3 (%3.4)      |
| Good         | 18 (%28.1)    | 10 (%40)      | 28 (%31.5)    |
| Moderate     | 29 (%45.3)    | 7 (%28)       | 36 (%40.4)    |
| Poor         | 17 (%26.6)    | 5 (%20)       | 22 (%24.7)    |
| Average      | 70.50 (14-87) | 77.32 (14-91) | 72.42 (14-91) |

Table 2: Singh index comparison between groups

| Parameter<br>Singh index | PFN (98)   | DHS (33)   | Total (131) |
|--------------------------|------------|------------|-------------|
| 1                        | -          | -          | -           |
| 2                        | 8 (8.2%)   | -          | 8 (6.1%)    |
| 3                        | 14 (14.3%) | 7 (21.2%)  | 21 (16%)    |
| 4                        | 32 (32.7%) | 8 (24.2%)  | 40 (30.5%)  |
| 5                        | 39 (39.8%) | 12 (36.4%) | 51 (38.9%)  |
| 6                        | 5 (5.1%)   | 6 (18.2%)  | 11 (8.4%)   |

PFN: Proximal Femoral Nail, DHS: Dynamic Hip Screw.

Patient's preoperative ASA scores were determined by looking at the anesthesia cards found in their files. The relationship between ASA scores and death was statistically significant ( $p=0.028$ ). A statistically significant difference was identified between the ages and the ASA scores of the population ( $p<0.05$ ). Age increased in direct proportion with the ASA Scores (Table 4).

Table 3: Mortality and death time relationship between groups

| Parameter           | PFN (98)     | DHS (33)  | Total (131)  | p     |
|---------------------|--------------|-----------|--------------|-------|
| Mortality           | 34 (34.7%)   | 8 (24.7%) | 42 (32.1%)   | 0.266 |
| Death time (months) | 13.71 (1-45) | 13 (1-44) | 13.57 (1-45) | 0.539 |

PFN: Proximal Femoral Nail, DHS: Dynamic Hip Screw.

Table 4: Comparison of AO classification and ASA score among groups

| Parameter         | PFN (98)   | DHS (33)   | Total (131) | p     |
|-------------------|------------|------------|-------------|-------|
| AO classification |            |            |             | 0.012 |
| 31A1              | 19 (19.4%) | 14 (42.4%) | 33 (25.2%)  |       |
| 31A2              | 52 (53.1%) | 9 (27.3%)  | 61 (46.6%)  |       |
| 31A3              | 27 (27.6%) | 10 (30.3%) | 37 (28.2%)  |       |
| ASA score         |            |            |             | 0.820 |
| ASA 1             | 4 (4.1%)   | 5 (15.2%)  | 9 (6.9%)    |       |
| ASA 2             | 56 (57.1%) | 13 (39.4%) | 69 (52.7%)  |       |
| ASA 3             | 26 (26.5%) | 12 (36.4%) | 38 (29%)    |       |
| ASA 4             | 12 (12.2%) | 3 (9.1%)   | 15 (11.5%)  |       |

PFN: Proximal Femoral Nail, DHS: Dynamic Hip Screw, ASA: American Society Anesthesiologists

Tip-apex distance measurement was also performed on the anterior and posterior radiographs of the patients postoperatively. The mean TAD distance was measured as 29.01 (20-45) mm in group 1 and 27.61 (18-40) mm in group 2 as described by Baumgartner ( $p=0.183$ ). Eight patients (6.1%) of the general population had cutout on x-rays taken during follow-up. Seven (7.1%) of them were in group 1 while the other one (3%) was in group 2 ( $p=0.679$ ).

Reduction success was compared between groups. Of the 98 patients in Group 1, 27 (27.6%) had anatomic reduction, while 63 (64.3%) had acceptable reduction and 8 (8.2%) had poor reduction. In Group 2, 18 (54.5%) of 33 patients had anatomic reduction, while 14 (42.4%) had acceptable reduction and 1 (3%) had a poor reduction. There was a significant

correlation between groups in terms of reduction success in favor of group 2 ( $p=0.017$ ).

## Discussion

In recent years, the average life span of the endeavor has been growing and the population of elderly people is increasing [5]. In our country, the incidence of intertrochanteric femur fracture increases with the increase of the elderly population. Literature is examined and it is observed that the female-male ratio of the intertrochanteric femur fractures is in different levels and the female dominance is preserved [6,7]. The number of women in our study was more in line with the literature. Reduced physical capacities of advanced age groups, accompanying systemic illnesses, loss of vision and hearing, protection from environmental impairments resulting from weakening of reflexes increase the risk of suffering simple trauma. Intertrochanteric fracture patients are often elderly people and almost all have additional systemic diseases. These patients should be mobilized early in order to be formed from a population of older age group. In order to avoid complications that increase mortality and morbidity such as deep vein thrombosis, pulmonary embolism, uremia, urinary tract infections, pressure ulcers, will cause by immobilization, the pre-fracture functional level should be acquired immediately [8,9]. For this reason, surgery should be the first choice in treatment; conservative treatment should be considered in terms of existing systemic diseases, instable and surgical interventions that increase the mortality and morbidity of the patient [6]. In our work; 9 (6.9%) were ASA1, 69 (52.7%) were ASA2, 38 (29%) were ASA3 and 15 (11.5%) were ASA4. Haentjens et al. [10] 80% of the study cases, Akçalı et al. [11] in 78% of cases, Kesemenli et al. [12] had systemic disease at 100%. As can be seen, patients have a high incidence of systemic disease at significant age with advanced age, which poses a risk for operation. Surgical treatment of intertrochanteric fractures should be done as soon as possible. According to Kenzora et al. [13], the annual mortality rate is significantly higher in the first 24 hours of surgery. They advocated detailed medical evaluation of the patient in the first 12-24 hours postoperatively, post-traumatization and the patient should be operated after optimal surgical conditions are achieved. Zuckerman et al. [14] found that in one series of 367 cases, the one-year mortality of patients who were treated after the second day of trauma was doubled. Moran et al. [15] examined the mortality rates of 2148 hip fracture patients who underwent surgery. In the first 30 days, the death rate was 9%, while the death rate in 90 days was 19% and the mortality rate in 1 year was 30%. The early (first 24 hours) or late (1-4 days or 4 days) surgical treatment did not change the mortality rate within the first 30 days. The first 24 hours or 1 to 4 days of surgical treatment did not change the 90-day and 1-year mortality rates. However, 90 days and 1 year mortality rates are increased in surgical treatment after 4 days [15]. In our study, preoperative waiting period was 5 days (1-22 days). There were 77 (58.8%) patients who had surgery after 4 days and their first, third, and 12th months did not show a significant increase in mortality rates. There were 6 patients who underwent surgery in the first 24 hours and one of them died after 15 months.

In the elderly, it should be discussed which implant is more suitable for the treatment of intertrochanteric femur fractures [16]. The success of treatment depends on the reduction and stability of the fracture rather than the selected fixation method [17]. In our study, the reduction success and the shortening of the union time were also observed. Although 45 patients with anatomical reduction had no shortness, it was seen that the cases with acceptable and weak reduction had shortness.

Harris hip scores were evaluated and it was observed that DHS-treated patients had better results than PFNA-treated patients independently of reduction. This can be explained by the surgeon doing his own randomization, that is, the more stable fractures and the younger patients preferred DHS. In addition, when applying PFNA, the screw leading to the head can be explained by the height of the nail in the medulla and the fact that the screw surgeon who is in charge is completely under control when applying DHS while connected to the shape.

Infection occurred in only 1 patient (0.8%) and this patient was re-operated to remove the implant (DHS). Antibiotic spacer application was performed after serial debridement. Orhun et al. [18] reported an infection rate of 1.9%. In Haentjens [10], the rate of infection was 2% in cases of osteosynthesis. Similar applications are attracting attention in the literature. In studies conducted, Burnett [19] reported a reduction of 4.7% infection by 0.7% with prophylaxis.

In the study performed by YZ Xu et al. on pertrochanteric patients with 51 PFNA and 55 DHS; It has been reported that the incision is shorter in PFNA, the blood loss is less, the duration of operation is less than DHS, the complication is less in patients with PFNA, and the length of mobilization is shorter in patients with PFNA given full load according to DHS [20]. A multicenter meta-analysis of Henry Wynn Jones et al. compared intramedullary nailing and sliding screw plate system in a total of 3202 patients with stable and unstable proximal femur fractures. This wide series meta-analysis showed that the fixation loss and re-operation rate of all types of fractures were greater than the intramedullary nailing than sliding plate system and that intramedullary nailing did not have any superiority to the sliding screw plate system in stabilized and unstable trochanteric fractures and intramedullary nail may be superior to sliding screw plate system in transverse and reversed oblique fractures [21]. Klinger et al. compared PFN and DHS on a total of 173 unstable intertrochanteric femur fracture patients. 122 patients underwent PFN and 51 patients underwent DHS. The functional outcomes of the patients were assessed according to the Merle D'Aubigne score, unlike our study. There was no significant difference in functional outcomes of DHS and PFN patients. The duration of PFN surgery and hospital stay were shorter than DHS. Patients with PFN were reported to mobilize at full load in a shorter time period and revision requirement in PFN was reported as 17.2% and DHS was 21.6%. In conclusion, they have shown that PFN is superior to DHS, especially in unstable fractures [22]. Pajarinen and colleagues [23] in 2005 evaluated PFN and DHS in terms of restoration of postoperative gait ability on 108 patients with pertrochanteric fractures and found that patients with PFN had a shorter restoration of postoperative walking ability than patients with DHS. They attributed this condition to a better restoration of the hip anatomy

of the PFN by DHS. After intertrochanteric fractures, avascular necrosis of the femur head is a very rare complication and the pathophysiology is still unknown. Baixauli et al. [24] detected avascular necrosis as 0.55% in their case series. Our 131 cases did not have femur head avascular necrosis in our series. Wilson et al. [25] reported venous thrombosis in 13 cases (1.3%) in 1015 cases series. Laohapoonrungrsee et al. [26] did not have deep vein thrombosis in their cases. For every patient with intertrochanteric femur fracture, if there is no contraindication besides extremity exercises, low molecular weight heparin is started preoperatively and postoperatively, and we give treatment for 1 month. We did not have pulmonary embolism or deep vein thrombosis in all patients. Foulongne et al. [27] compared two groups which intramedullary nails and dynamic hip-screw methods in a case-control study of 30 patients. Intramedullary nailing was found to be superior in terms of operation time, duration of hospital stay, functional outcome, and bone healing. In our study, functional hip scores were higher when dynamic hip screws were applied. In a prospective randomized study by Guo et al. [28] 90 patients with intertrochanteric femur fracture treated with proximal compression plate or proximal femoral nail were compared in terms of operative time, intraoperative and peroperative blood loss, duration of hospital stay, postoperative complication rates and functional outcomes at the end of follow-up. No statistically significant difference was found for the comparison criteria between these two implants. In a study conducted by Chua et al, 63 (25 PFNA, 38 DHS) patients with intertrochanteric femur fractures greater than 60 years who had dynamic hip screws or proximal femoral nails were evaluated. Patients were compared for functional recovery. Two patients who treated with PFNA underwent cutout due to poor reduction, and 1 patient had avascular necrosis after cutout. The authors found that PFNA was superior in terms of the functional status of the patient and return to pre-fracture mobilization as opposed to our study [29]. Varela-Egocheaga and colleagues conducted a prospective, randomized study of 80 patients with stable intertrochanteric femur fractures aged over 60 years old who were treated with a proximal compression plate or proximal femoral nail. There was no statistically significant difference between the two implant types in terms of hospitalization time, perioperative blood loss, functional results after 1 year follow-up, neck-shaft angle, fracture collapse and mortality [30]. Shen and colleagues have evaluated 5 randomized control trials involving patients with pertrochanteric femur fractures treated with dynamic hip screws or proximal femoral nails in a meta-analysis study. Authors who determined that PFNA resulted in less blood loss and fewer complications did not find a significant difference in terms of mortality and duration of operation similarly in our study [31]. In a meta-analysis study of 1344 patients with 17 prospective studies, Yuan X et al reported that PFNA significantly reduced fixation loss, did not impair fracture union duration, and had significant height in Harris hip score. Postoperative 1 year mortality, femur head avascular necrosis, and femur fracture during operation did not show any significant difference [32]. In our study, reduction success and Harris hip scores were found to be better in cases with DHS.

In conclusion, patients should be examined in terms of systemic diseases in the preoperative period and necessary

internal consultations should be done to ensure that they enter the operation in the most suitable health conditions. It was found that cutout formation was also effective in osteoporosis as well as TAD distance. Bone trabeculae were more prominent, and in cases not described as osteoporotic, reduction success was achieved and consequently bone union success was higher, and functional outcomes were also better in these patients. We concluded that there was no effect on the mortality of the preoperative waiting period, as the age increased, the systemic diseases, thus increasing the ASA scores and increasing the ASA score, also increased the mortality. Harris hip scores increased with the increase in reduction success.

Fracture type, age, fracture type and osteoporosis grade were effective on Harris Hip Score. Reduction success also affected the shortening of the union time and the absence of shortness. In the DHS group, Harris hip scores were higher because reduction success was better.

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