# Total hip replacement in active elderly patients with femur neck fracture, Aden, Yemen

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## Abstract

Objective: To evaluate the results of total hip replacement for patients with femoral neck fractures in Aden, Yemen

Materials and method: Patients were retrospectively sought who suffered a femoral neck fracture and who were all operated on by the author and a senior surgeon in the period from January 2018 to April 2020. The study was conducted at the department of orthopedic surgery, in Alnaqeeb private hospital in Almansoora, Aden, Yemen.

Statistical analyses were performed using the statistical program SPSS, version 17.

We expressed distribution of variables using means and standard deviation (SD). Fisher test was used and p-value ≤ 0.05 was considered as statistically significant.

Results: The study patients were 70. All patients suffered from femoral neck fracture and were operated on for total hip replacement. They were (50%) females and (50%) males with a ratio female to male 1:1. The mean age of all patients was 68.9 ± 7.8 years (range, 60 to 87 years). The patients of the age group 60 – 70 were predominant with (72.9%). There was statistical significant difference between the age groups and sex of patients (p=0.05).

Causes of fractures were fall down (50%) patients, degenerative (25.7%) patients, inflammatory 7 (10%), and road traffic accident in (10%) patients. Neck femur fractures with severe displacement were predominant with (60%).

Intraoperative periprosthetic fracture was found in 3 (4.3%) patients, post-operative periprosthetic fracture was also found in 5 (7.1%) patients. Also, we found implant failure or breakage in (1.4%), dislocations in (12.9%) patients and wound infections in (5.7%). Lower limbs discrepancy was found in (1.4%) patients.

Conclusion: Our study and previous published studies have shown that the complication rates are significantly lower.

Key words: Femur neck fracture, elderly patients, total hip replacement, Aden

## Introduction

Femoral neck fractures (FNF) account for about 3.6% of adult fractures, which is one of the more common fractures in the body. FNF is more common in elderly patients, and generally refers to the fracture in the part of the femoral head down to the base of the femoral neck [1,2,3].

Femoral neck is the weakest zone of proximal femur. Fracture of femoral neck is a type of fracture between femoral head and trochanteric, almost intracapsular and is quite common in elderly people, closely related to bone quality [4].

Femoral neck fracture can be treated by preservative treatment, osteosynthesis or hip replacement surgery. However, the risk of bone loss and the need for patient care make the methods of preservation or osteosynthesis less commonly used in reality. Total hip arthroplasty surgery can help patients move early, avoid long-term complications and be able to resume movement ability quickly, so it is considered an ideal method to treat femoral neck fracture. In recent years, with the advancement of anesthesia, the ability to intervene in the elderly is no longer a problem. In addition, surgical advances with minimally invasive surgery reduce the discomfort and pain of surgical wounds, so the rehabilitation of patients after surgery is earlier and better [5,6,7].

Several authors reported that total hip arthroplasty (THA) in elderly patients is advantagoues in that it leads to superior functional outcomes and lower reoperation rates compared to hemiarthroplasty (HA). With increased activity and an independent elderly population, the use of THA for managing femoral neck fracture is likely to increase [8].

## Objective

To evaluate the results of total hip replacement for patients with femoral neck fractures in Aden, Yemen.

## Materials and Method

Patients were retrospectively sought who suffered a femoral neck fracture and were all operated on by the author and a senior surgeon in the period from January 2018 to April 2020. The study was conducted at the Department of orthopedic surgery, in Alnaqeeb private hospital in Almansoora, Aden, Yemen.

In this study, patient charts, surgery reports and pre- and post-operative reports were reviewed.

The collected data were demographic characteristics, side of fracture, causes of fractures, diagnosed comorbidities, diagnosis and pre- and post-operative mobility.

Additionally, the postoperative complications were reviewed and put into groups (intraoperative periprosthetic fracture, post-operative periprosthetic fracture, implant failure or breakage, dislocations, wound infections and lower limbs discrepancy). We identify the occurring of complications with no and yes.

We collected also, the following data: previous hip surgery, early results of total hip replacement, and previous hip joint infection before 1 year.

Statistical analyses were performed using the Statistical program SPSS, version 22.

We expressed distribution of variables using means and standard deviation (SD). Fisher test was used and p-value ≤ 0.05 was considered as statistically significant.

## Results

We enrolled 70 patients who suffered femoral neck fracture and who were operated on for total hip replacement, into our study. The study patients included 35 (50%) females and 35 (50%) males with a ratio female to male 1:1.

The mean age of all patients was 68.9 ± 7.8 years (range, 60 to 87 years). The mean age of male patients was 71.9 ± 8.4 years (range 60 – 87 years) and the mean age of female patients was 66.0 ± 5.9 (range 66 – 85 years). The difference between means related to sex was statistically significant (p = 0.001).

The patients of the age group 60 – 70 were predominant with 51 (72.9%) followed by the age group 71 – 80 years old with 12 (17.1%) and the age group more than 80 years old with 7 (10%), as shown in Table 1 and Figure 1.

Table 2 illustrates the distribution of age groups, sides, causes and diagnosis related to sex of the study patients. We found 30 (42.9%) female patients of the age group 60 – 70 years old, while female patients of the age 71 – 80 years old were 4 (5.7%) and females aged more than 80 years was 1 (1.4%). The male patients of the age group 60 – 70 years represented 21 (30%) and patients of the age 71 – 80 years old were 8 (11.4%) and males aged more than 80 years were 6 (8.6%). There was a statistically significant difference between the age groups and sex of patients (p=0.05), as shown in Table 2.

Side of fractures were predominant 43 (61.4%) in the left side and distributed as 24 (34.3%) females and 19 (27.1%) males. There was no statistical significance between values of sides related to sex (p>0.05) as shown in Table 2.

In this study, causes of fractures were fall 35 (50%) patients, degenerative 18 (25.7%) patients, inflammatory 7 (10%), Road Traffic Accident (RTA) in 7 (10%) patients and post neck femur fractures in 3 (4.3%) patients. There was no statistical relation between causes of fractures and sex (p > 0.05), (Table 2 and Figure 2).

Neck femur fractures with severe displacement were predominant with 42 (60%) followed by osteoarthrosis with

18 (25.7%), end stage inflammatory necrosis 7 (10.0%) and avascular necrosis in 3 (4.3%) patients. There was no statistically relation between diagnosis of fractures and sex ($p > 0.05$), (Table 2).

Table 3 illustrates the distribution of comorbidities and complications of total hip replacement in the study patients with femur neck fracture.

Twenty-two (31.4%) patients were found with comorbidities.

We used cemented prosthesis in 63 (92%) and uncemented prostheses in 7 (10%) in total hip arthroplasty

Intraoperative periprosthetic fracture was found in 3 (4.3%) patients, post-operative periprosthetic fracture was also found in 5 (7.1%) patients. Also in Table 3 we found implant failure or breakage in 1 (1.4%), dislocations in 9 (12.9%) patients and wound infections in 4 (5.7%). Previous hip surgeries were found in 15 (21.4%) patients and lower limbs discrepancy found in 1 (1.4%) patient. The Table illustrates also, the early results of total hip replacement after femur neck fracture in 2 (2.9%) cases and previous hip joint infection before 1 year was found in 3 (4.3%) cases.

**Table 1: Distribution of demographic characteristics of the study patients (n = 70)**

| Variable | Ratio | Range | Mean | No | % | |
|---|---|---|---|---|---|---|
| *Sex:* | | | | | | |
| Males | | | | 35 | 50.0 | |
| Females | | | | 35 | 50.0 | |
| Male to Female | 1 :1 | | | | | |
| Age range (years): | | | | | | |
| All patients | | 60 – 87 | | | | |
| Male patients | | 60 – 87 | | | | |
| Female patients | | 66 – 85 | | | | |
| Mean age ± SD* (years): | | | | | | |
| All patients | | | 68.9 ± 7.8 | | | P = |
| Male patients | | | 71.9 ± 8.4 | | | 0.001 |
| Female patients | | | 66.0 ± 5.9 | | | |
| Age groups (years): | | | | | | |
| 60 – 70 | | | | 51 | 72.9 | |
| 71 – 80 | | | | 12 | 17.1 | |
| > 80 | | | | 7 | 10.0 | |

SD*: Standard deviation;

**Figure 1: Distribution of patients related to age groups (n=70)**

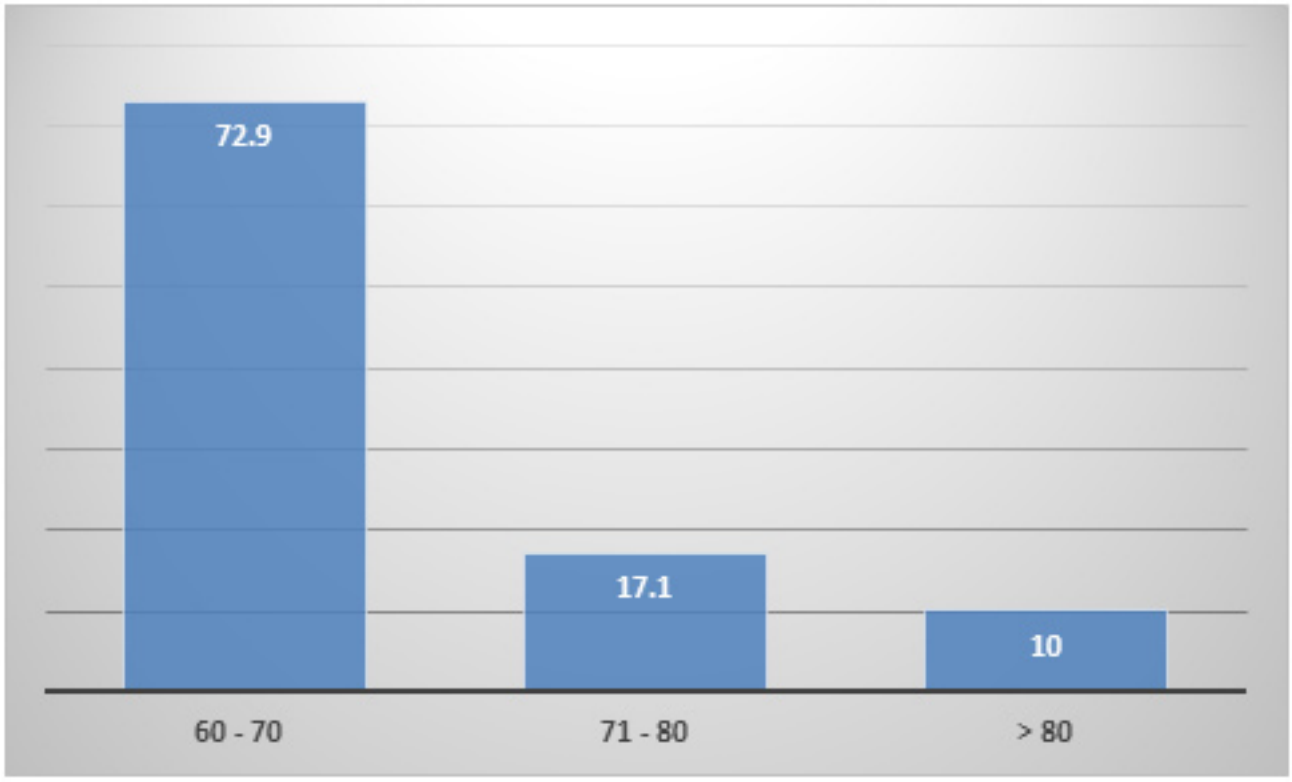

**Table 2: Distribution of age groups, sides, causes and diagnosis related to sex of the study patients (n=70)**

| Variables | Sex | | | | Total | | P-value |
|---|---|---|---|---|---|---|---|
| | Females | | Males | | | | |
| | No | (%) | No | (%) | No | (%) | |
| *Age groups (years):* | | | | | | | |
| 60 - 70 | 30 | (42.9) | 21 | (30.0) | 51 | (72.9) | |
| 71 – 80 | 4 | (5.7) | 8 | (11.4) | 12 | (17.1) | P = 0.05 |
| > 80 | 1 | (1.4) | 6 | (8.6) | 7 | (10.0) | |
| *Side:* | | | | | | | |
| Left | 24 | (34.3) | 19 | (27.1) | 43 | (61.4) | P > 0.05 |
| Right | 11 | (15.7) | 16 | (22.9) | 27 | (38.6) | |
| *Cause:* | | | | | | | |
| Fall | 14 | (20.0) | 21 | (30.0) | 35 | (50.0) | |
| Degenerative | 11 | (15.7) | 7 | (10.0) | 18 | (25.7) | P > 0.05 |
| Inflammatory | 5 | (7.1) | 2 | (2.9) | 7 | (10.0) | |
| Road traffic accidents | 4 | (5.7) | 3 | (4.3) | 7 | (10.0) | |
| Post neck femur fractures | 1 | (1.4) | 2 | (2.9) | 3 | (4.3) | |
| *Diagnose:* | | | | | | | |
| NFF with severe displacement | 18 | (25.7) | 24 | (34.3) | 42 | (60.0) | P > 0.05 |
| OA | 11 | (15.7) | 7 | (10.0) | 18 | (25.7) | |
| End stage inflammatory necrosis | 5 | (7.1) | 2 | (2.9) | 7 | (10.0) | |
| Avascular necrosis | 1 | (1.4) | 2 | (2.9) | 3 | (4.3) | |

NFF with severe displacement = Neck Femur Fracture with severe displacement
OA = Osteoarthrosis

**Figure 2: Distribution of causes of fractures related to sex**

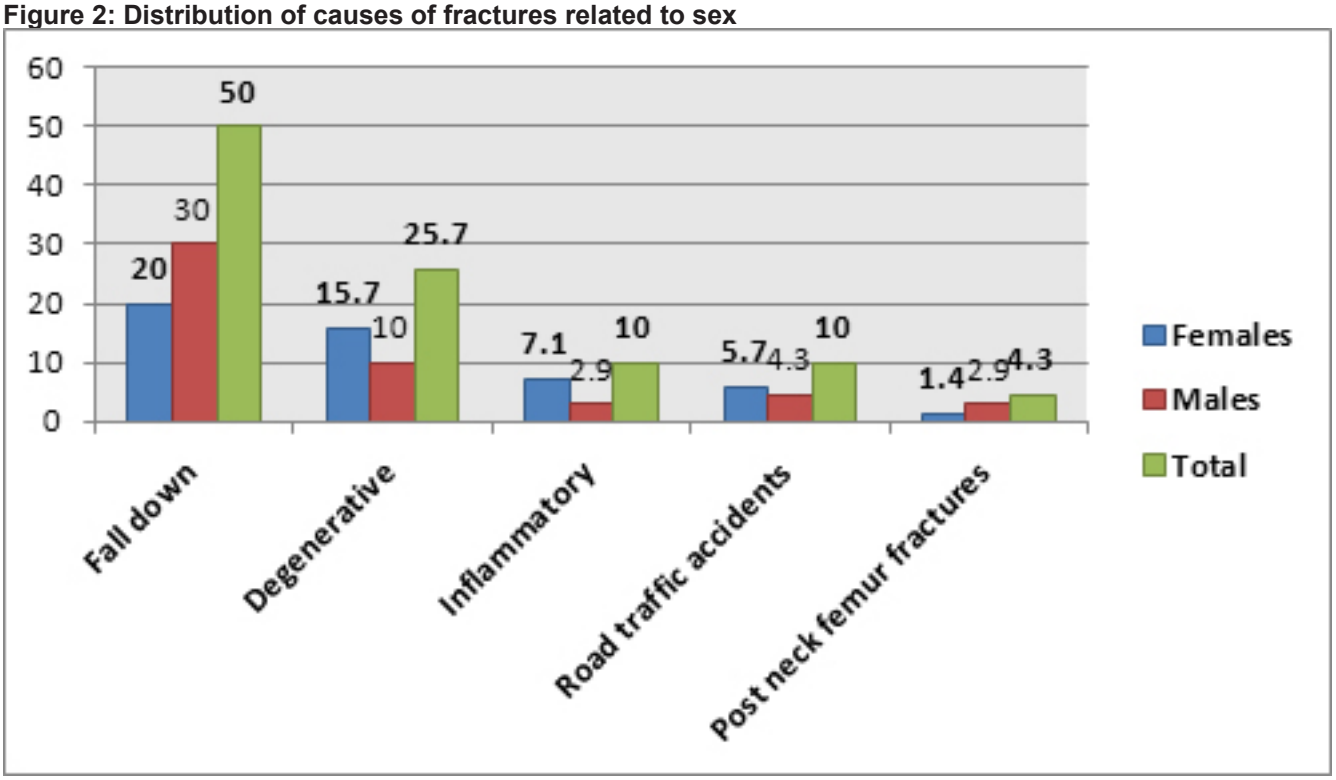

**Table 3: Distribution of comorbidities and complications of total hip replacement in patients with femur neck fracture (n = 70)**

| Variables | No | % |
|---|---|---|
| *Comorbidities:* | | |
| No | 48 | 68.6 |
| Yes | 22 | 31.4 |
| *Cementation:* | | |
| Cemented | 63 | 90 |
| Uncemented | 7 | 10 |
| *Intraoperative periprosthetic fracture:* | | |
| No | 67 | 95.7 |
| Yes | 3 | 4.3 |
| *Post-operative periprosthetic fracture:* | | |
| No | 65 | 92.9 |
| Yes | 5 | 7.1 |
| *Implant failure or breakage* | | |
| No | 69 | 98.6 |
| Yes | 1 | 1.4 |
| *Dislocations:* | | |
| No | 61 | 87.1 |
| Yes | 9 | 12.9 |
| *Wound infection:* | | |
| No | 66 | 94.3 |
| Yes | 4 | 5.7 |
| *Previous hips surgery:* | | |
| No | 55 | 78.6 |
| Yes | 15 | 21.4 |
| *Lower limbs discrepancy:* | | |
| No | 69 | 98.6 |
| Yes | 1 | 1.4 |
| *EARTHREPL*:* | | |
| No | 68 | 97.1 |
| Yes | 2 | 2.9 |
| *Previous hip joint infection before 1 year:* | | |
| No | 67 | 95.7 |
| Yes | 3 | 4.3 |

EARTHREPL* = Early results of total hip replacement after femur neck fracture in active elderly patients

## Discussion

Femoral neck fractures (FNFs) will bring baneful consequences to patients due to their high morbidity, disability rate, economic burden, and mortality, and the rate is rapidly growing because of the increasing number of the elderly [9]. Arthroplasty is commonly recommended for displaced femoral neck fractures (67% of all types FNFs) in the elderly (age > 65 years) and can be categorized as total hip arthroplasty (THA) [10].

In our study females were 35 (50%) and males were 35 (50%) with a ratio female to male 1:1.

Kebaetse et al [11] in their study in Botswana reported that hip fractures were nearly as frequent in men as in women. Also, this feature has been seen in other countries [12,13].

In our present study we found also, the mean age of all patients was 68.9 ± 7.8 years (range, 60 to 87 years). The mean age of male patients was 71.9 ± 8.4 years (range 60 – 87 years) and the mean age of female patients was 66.0 ± 5.9 (range 66 – 85 years).

Johnell et al [14] reported that more women than men sustain FNFs and females were older than men when the fracture occurs. Most of the men were in the age group ≤ 60 years, for which high-energy trauma is more common. Previous studies [15,16] reported that the incidence of FNFs increases gradually with age, with a marked increase after age 75 years.

A study by Trung et al [17] from Vietnam reported that the mean age of patients in their study was 65.7 ± 8.3 years old, with the age group under 75 years accounting for 90% and 40% of the patients were under 65 years.

We found in the present study (42.9%) female patients of the age group 60 – 70 years old, while female patients of the age 71 – 80 years old were (5.7%) and females aged more than 80 years were (1.4%). The male patients of the age group 60 – 70 years represented (30%) and patients of the age 71 – 80 years old were (11.4%) and males aged more than 80 years were (8.6%). There was a statistically significant difference between the age groups and sex of patients (p=0.05).

Wolfovitch et al [18] reported similar findings to our results from Salvador in which they mentioned the mean age of their study patients was 66.77 years ± SD 15.73 years. Patients were predominantly aged between 71 – 80 years (31.3%).

In this study, causes of fractures were fall down (50%) patients, degenerative (25.7%) patients, inflammatory (10%), Road Traffic Accident (RTA) in (10%) patients and post neck femur fractures in (4.3%) of patients. There is no statistically significant relation between causes of fractures and sex (p > 0.05).

Femoral neck fractures are associated with low energy falls in the elderly. In younger patients sustaining a femoral neck fracture, the cause is usually secondary to high-energy trauma such as a fall from a substantial height or motor vehicle accidents [19].

Koaban et al [20] reported in their study that the most common cause of FNFs in their studied population was secondary to a fall injury, which was documented in (53.6%) patients, followed by RTA in (23.2%) patients.

We found in our current study (31.4%) patients injured by femoral neck fractures complained of comorbidities.

Edelmuth et al [21] reported in their study from Brazil the following: regarding comorbidities, 11.9% of the patients had no associated disease, 37.3% had one comorbidity, 17.9% had two comorbidities, and 22.3% had three. In 10.4% of the study population, more than four comorbidities were observed, and the main comorbidities found in this population were systemic arterial hypertension, diabetes mellitus, and heart diseases.

In the current study the cemented prosthesis were used in 63 (92%) and uncemented prostheses in 7 (10%) in total hip arthroplasty.

Cemented or uncemented total hip replacement remains a widely accepted method for hip replacement after fracture [22]. Promising results have been described for patients with FNFs treated with a cemented or uncemented total hip replacement [23].

In the present study, intraoperative periprosthetic fracture was found in (4.3%) cases, and post-operative periprosthetic fracture found in (7.1%) cases.

Intraoperative periprosthetic fracture is an often-overlooked category of patients who can end up with poor results and early loosening if fracture is not identified intraoperatively and managed correctly. Such results affect both femoral and acetabular fixation and are often under recognized and under reported [24]. As one might expect, reported rates of Intraoperative periprosthetic fracture are significantly higher in uncemented prostheses. Two studies suggest the rate in cemented arthroplasty is around 0.3% to 1.2%, [25,26] and several studies of uncemented implants suggest rates of 2.95% to 27.8% depending on a multitude of variables [25,26,27].

Suenghwan et al [8] reported that in their study of 83 hips, perioperative complications occurred in nine hips (10.8%). One patient (1.2%) experienced an intraoperative periprosthetic fracture around the trochanteric region, which was treated by cerclage wiring. Two patients (2.4%) had superficial wound infections that required debridement and treatment with antibiotics without significant revision surgery. One patient (1.2%) had a single dislocation due to delirium in the early postoperative period, which was managed with closed reduction; no further dislocations were noted during the study period. One pulmonary

thromboembolism (1.2%) was identified postoperatively and treated with seven months of warfarin. There was no ceramic breakage during the follow-up period.

In our present study we found implant failure or breakage in 1 (1.4%), dislocations in 9 (12.9%) patients and wound infections in 4 (5.7%).

Nosa et al [28] mentioned that previous hip surgeries were found in 15 (21.4%) patients and lower limbs discrepancy found in 1 (1.4%) patient.

In the present study we found implant failure or breakage in 1 (1.4%), dislocations in 9 (12.9%) patients and wound infections in 4 (5.7%).

Prosthetic dislocation is one of the most common causes of implant failure after total hip arthroplasty [29]. The reported dislocation rate after primary total hip arthroplasty is 0.3-10% [30] and is much higher after revision total hip arthroplasty (5-30%) [31]. The cause of a dislocated prosthesis can be multifactorial, including both surgeon and patient related factors [32].

Liu et al [33] reported in their published study that among the 1240 patients, a total of 94 surgical site infections were observed, demonstrating an overall incidence rate of 7.58%. These 94 patients were specifically classified as superficial incision infection in 76 cases and deep infection in 18 patients, giving the incidence of 6.13% and 1.45% for superficial and deep surgical site infection respectively.

## Conclusion

Our findings confirm the opinion that a total hip replacement is the preferred treatment for a relatively healthy, active elderly patient with a displaced femoral neck fracture. Our study and previous published studies have shown that the complication rates are significantly lower. Further studies are needed to find out the incidence and prevalence rates of femur neck fracture and their treatment procedures in Aden Governorate.

## References

1. Guyen O. Hemiarthroplasty or total hip arthroplasty in recent femoral neck fractures? Orthop Traumatol Surg Res. 2019;105(1):95–101.
2. Florschutz AV, Langford JR, Haidukewych GJ, Koval KJ. Femoral neck fractures: current management. J Orthop Trauma. 2015;29(3):121–9.
3. Miller BJ, Callaghan JJ, Cram P, Karam M, Marsh JL, Noiseux NO. Changing trends in the treatment of femoral neck fractures: a review of the American Board of Orthopaedic surgery database. J Bone Joint Surg Am. 2014;96(17):e149.
4. Herberts P, Malchau H (2000) Long-term registration has improved the quality of hip replacement: A review of the Swedish THR Register comparing 160,000 cases. Acta Orthop Scand 71: 111-121.
5. Wenz JF, Gurkan I, Jibodh SR (2002) Mini incision total hip arthroplasty: a comparative assessment of perioperative outcomes. Orthopedics 25: 1031-1043.
6. Waldman BJ (2012) Minimally invasive total hip replacement and perioperative management: early experience. J South Orthop Assoc 11: 213 - 217.
7. Berry DJ, Berger RA, Callaghan JJ, Dorr LD, Duwelius PJ, et al. (2003) Minimally invasive total hip arthroplasty. Development, early results, and a critical analysis. J Bone Joint Surg Am 85-A: 2235-2246.
8. Suenghwan Jo, Se Hwan Lee. Sun-Jung Yoon. Clinical Outcomes of Total Hip Arthroplasty for Displaced Femoral Neck Fractures in Patients 80 Years of Age and Older Selected by Clinical Frailty Score. Hip Pelvis. 2020; 32(3): 148-155
9. Kim BS, Lim JY, Ha YC. Recent epidemiology of hip fractures in South Korea. Hip Pelvis. 2020;32(3):119–124.
10. Miyamoto RG, Kaplan KM, Levine BR, Egol KA, Zuckerman JD. Surgical management of hip fractures: an evidence-based review of the literature. I: femoral neck fractures. J Am Acad Orthop Surg. 2008; 16(10): 596–607.
11. Kebaetse M, Nkhwa S, Mogodi M, et al. Epidemiology of hip fracture in Botswana. Arch Osteoporos. 2021; 16(24): https://doi.org/10.1007/s11657-021-00885-x
12. Kanis JA, Odén A, McCloskey EV, Johansson H, Wahl D, Cyrus Cooper C, on behalf of the IOF Working Group on Epidemiology and Quality of Life (2012). A systematic review of hip fracture incidence and probability of fracture worldwide. Osteoporos Int 23:2239–2256
13. Elffors L, Allander E, Kanis JA, Gullberg B, Johnell O, Dequeker J, Dilzen G, Gennari C, Lopez-Vaz AA, Lyritis G, Mazzuoli GF, Miravet L, Passeri M, Perez Cano R, Rapado A, Ribot C (1994). The variable incidence of hip fracture in Southern Europe. The MEDOS Study. Osteoporos Int 4:253–263
14. Johnell O, Kanis JA. An estimate of the worldwide prevalence, mortality and disability associated with hip fracture. Osteoporos Int. 2004;15(11):897–902.
15. Sundkvist J, Bruggeman A, Sayed-Noor A, Moller M, et al. Epidemiology, classification, treatment, and mortality of adult femoral neck and basicervical fractures: an observational study of 40,049 fractures from the Swedish Fracture Register. J Ortho Surg Res. 2021; 16: 561. Available at: https://doi.org/10.1186/s13018-021-02701-1
16. Curtis EM, van der Velde R, Moon RJ, van den Bergh JP, Geusens P, de Vries F, et al. Epidemiology of fractures in the United Kingdom 1988-2012: variation with age, sex, geography, ethnicity and socioeconomic status. Bone. 2016;87:19–26.
17. Trung DT, Trung HP, Quang SNT, Hoang TN, Van KT. Evaluation of the result of total arthroplasty with minimally invasive surgery for fracture of femoral neck caused by trauma in Vietnamese adult. Annals of Musculoskeletal Medicine. 2017; 11: 43-45
18. Wolfovitch LA, Falcao FRC, Dias BA, et al. Clinical and epidemiological profile of patients undergoing total hip arthroplasty. Rheumatol Orthop Med. 2017; 2:
19. Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int. 2006 Dec;17(12):1726-33.

20. Koaban S, Alatassi R, Alharbi S, Alshehri M, Alghamdi K. The relationship between femoral neck fracture in adult and avascular necrosis and nonunion: A retrospective study. Annals of Medicine and Surgery. 2019; 39: 5 - 9
21. Edelmuth SVCL, Sorio GN, Sprovieri FAA, Gali JC, Peron SF. Comorbidities, clinical intercurrences, and factors associated with mortality in elderly patients admitted for a hip fracture. Rev Bras Ortop. 2018; 53(5): 543-551
22. Clarke-Jenssen J, Westberg M, Roise O, Storeggen SAO, Bere T, Silberg I, et al. Reduced survival for uncemented compared to cemented total hip arthroplasty after operatively treated acetabular fractures. Injury. 2017;48(11):2534–9.
23. Tezuka T, Heckmann ND, Bodner RJ, Dorr LD. Functional safe zone is superior to the Lewinnek safe zone for total hip arthroplasty: why the Lewinnek safe zone is not always predictive of stability. J Arthroplasty. 2019;34(1):3–8
24. Young PS, Patil S, Meek RMD. Intraoperative femoral fractures. Bone Joint Res. 2018; 7(1): 103-104
25. Berry DJ. Epidemiology: hip and knee. Orthop Clin North Am. 1999; 30:183-190.
26. Abdel MP, Watts CD, Houdek MT, Lewallen DG, Berry DJ. Epidemiology of periprosthetic fracture of the femur in 32,644 primary total hip arthroplasties: a 40-year experience. Bone Joint J. 2016; 98-B: 461-467.
27. Stuchin SA. Femoral shaft fracture in porous and press-fit total hip arthroplasty. Orthop Rev. 1990;19:153-159.
28. Nosa JM, Munos JM, Riveros EA, et al. Leg length discrepancy after total hip arthroplasty: comparison of 3 intraoperative measurement methods. Hip Int. 2018; 28(3): 254-258
29. American Joint Replacement Registry. 2019 Sixth AJRR Annual Report on Hip and Knee Arthroplasty Data. 2019; http://connect.ajrr.net/2019-ajrr-annual-report.
30. Parvizi J, Picinic E, Sharkey PF. Revision total hip arthroplasty for instability: surgical techniques and principles. J Bone Joint Surg Am. 2008;90(5):1134–42
31. Berend KR, Sporer SM, Sierra RJ, Glassman AH, Morris MJ. Achieving stability and lower-limb length in total hip arthroplasty. J Bone Joint Surg Am. 2010;92(16):2737–52
32. Wetters NG, Murray TG, Moric M, Sporer SM, Paprosky WG, Della Valle CJ. Risk factors for dislocation after revision total hip arthroplasty. Clinical Orthopaedics and Related Research. 2013;471(2):410–6
33. Xiaopo Liu, Zhijie Dong, Jun Li, Yuno Feng. Factors affecting the incidence of surgical site infection after geriatric hip fracture surgery: a retrospective multicenter study. Journal of Orthopaedic Surgery and Research. 2019; 14: