ISSN: 2651-4451 • e-ISSN: 2651-446X

Turkish Journal of Physiotherapy and Rehabilitation

2024 35(1)97-103

Muhammed Taha TUFEK, MSc., PT[1]
Cansu GEVREK-ASLAN, MSc., PT[2]
Omur CAGLAR , Prof., MD[3]
Gizem Irem KINIKLI, Prof., PT[1]

1 *Hacettepe University, Faculty of Physical Therapy and Rehabilitation, Department of Musculoskeletal Physiotherapy and Rehabilitation, Ankara, Turkey.*
2 *Ankara Medipol University, Vocational School of Health Services, Department of Therapy and Rehabilitation, Programme of Physiotherapy, Ankara, Turkey*
3 *Hacettepe University, Faculty of Medicine, Department of Orthopedics and Traumatology, Ankara, Turkey.*

Correspondence (İletişim):

Cansu GEVREK-ASLAN, MSc., PT
E-mail: gevrekcansu@gmail.com
Ankara Medipol University, Vocational School of Health Services, Department of Therapy and Rehabilitation, Programme of Physiotherapy, Ankara, Turkey

1Muhammed Taha TUFEK
E-mail: m.taha.tufek@gmail.com
ORCID: 0000-0002-9356-4096

Cansu GEVREK ASLAN
E-mail: gevrekcansu@gmail.com
ORCID: 0000-0003-0750-3033

Omur CAGLAR
E-mail: dromurcaglar@gmail.com
ORCID: 0000-0002-0346-8528

Gizem İrem KINIKLI
E-mail: cguvendik@hotmail.com
ORCID: 0000-0003-1013-6393

Received: *21.02.2023 (Geliş Tarihi)*
Accepted: *12.12.2023 (Kabul Tarihi)*

LONG-TERM FUNCTIONAL OUTCOMES AND QUALITY OF LIFE IN YOUNG ADULTS WITH INTERNAL FIXATION OF FEMORAL SHAFT FRACTURE: A CROSS-SECTIONAL STUDY

ORIGINAL ARTICLE

ABSTRACT

Purpose: Although internal fixation surgery of femoral shaft fracture (FSF) has high rates of union, it affects the patient's functionality and quality of life due to additional health conditions depending on the traumatic nature of these injuries. This cross-sectional study aimed to investigate the long-term functional outcomes and quality of life of young adults who underwent internal fixation of isolated FSF to compare with healthy peers.

Methods: The Harris Hip Score (HHS) and Stair Climb Test (SCT) were used to evaluate the functionality of the participants. The EuroQol 5-Dimension Questionnaire (EQ-5D) was used to assess the quality of life.

Results: Twenty young adult volunteers with internal fixation surgery aged 18-55 years are included in the FSF group (mean age: 39.55±11.92 years; duration after surgery: 28±7.2 months) and 20 healthy peers (mean age: 42.75±8.83 years) as the control group. The HHS and EQ-5D scores were lower ($p<0.001$) in patients with FSF; however, the SCT test time was longer in patients with FSF compared to healthy controls ($p<0.001$).

Conclusion: The results of the present study demonstrated that functional outcomes and quality of life in patients with FSF did not improve well enough compared to healthy peers 2 years after internal fixation surgery. We suggest that assessment of patients with FSF in a long-term period is needed, even after fracture union, to have a better outcome.

Keywords: Femoral Fractures, Femur, Function, Quality of life

FEMUR ŞAFT KIRIĞINA BAĞLI İNTERNAL FİKSASYON CERRAHİSİ GEÇİRMİŞ GENÇ ERİŞKİNLERDE GEÇ DÖNEM FONKSİYONEL SONUÇLAR VE YAŞAM KALİTESİ: KESİTSEL BİR ÇALIŞMA

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Femur cisim kırığı (FCK) için yapılan internal fiksasyon cerrahilerinde kaynama oranları yüksek olmakla birlikte, yaralanmaların travmatik yapısı nedeniyle oluşan ek sağlık durumları hastaların fonksiyonelliğini ve yaşam kalitesini olumsuz etkileyebilmektedir. Bu kesitsel çalışmanın amacı, izole FCK'larında internal fiksasyon uygulanan genç erişkinlerin geç dönem fonksiyonel sonuçlarını ve yaşam kalitelerini sağlıklı yaşıtlarıyla karşılaştırmaktır.

Yöntem: Çalışmaya 18-55 yaş arasında olan ve internal tespit cerrahisi geçirmiş 20 genç yetişkin gönüllü (ortalama yaş: 39,55±11,92 yıl; ameliyat sonrası süre: 28±7,2 ay) ve benzer yaş ve cinsiyette 20 sağlıklı birey (ortalama yaş: 42,75±8,83) dahil edildi. Katılımcıların fonksiyonelliğini değerlendirmek için Harris Kalça Skoru ve Merdiven Çıkma Testi kullanıldı. Yaşam kalitesini değerlendirmek için EuroQol Yaşam Kalitesi Ölçeği kullanıldı.

Sonuçlar: Cerrahi geçiren bireylerde, kalça fonksiyonelliği ve yaşam kalitesi puanları, sağlıklılara göre daha düşük bulunurken ($p<0.001$); merdiven çıkma test süresi, sağlıklı bireylerden daha uzun bulundu ($p<0.001$).

Tartışma: Bu çalışmanın sonuçları, femur cisim kırığına bağlı internal fiksasyon cerrahisi geçiren bireylerde, 2 yıl sonra bile kalça ile ilişkili fonksiyonel sonuçların ve yaşam kalitesinin sağlıklı akranlarına göre yeterince düzelmediğini performans testlerinde de yetersizlik olduğunu göstermiştir. Cerrahiden sonra uzun dönemde femur cisim kırığına bağlı internal fiksasyon cerrahisi geçiren bireylerde fonksiyonel yetersizliklerin devam etmesi fizyoterapi ve rehabilitasyon uygulamalarının kalçanın fonksiyonel ve yaşam kalitesi ile ilişkili sonuçlarının geliştirilmesi için bireysel ihtiyaçlara göre devam ettirilmesinin gerekli olduğunu düşünüyoruz.

Anahtar Kelimeler: Femoral Kırıklar, Femur, Fonksiyon, Yaşam Kalitesi

INTRODUCTION

Femoral shaft fracture (FSF) is defined as the disruption of the anatomical integrity of the femoral diaphysis, from 5 cm below the trochanter minor up to the proximal part of the adductor tubercle (1). FSF is a severe injury that occurs between 37/100.000 a year (2). Injury is most seen in the young population aged 15-40 years who have been exposed to high-energy trauma such as traffic accidents (80-90%), firearm injuries, and falling from heights. Young adult males have a higher rate of injury than females (3). The primary objective in the treatment of FSF is to restore the anatomical integrity of the extremity and to enable individuals to regain their functions in daily life before the fracture.

Currently, the rate of the union varies between 95-99%, and the rate of infection after internal fixation is less than 1% (4). Although surgical treatment is effective in achieving fracture union, it has been reported that the functional performance of the patients after surgery was decreased due to the high-energy traumatic nature of these injuries and possible additional surgical interventions. In the literature, post-surgical persistent problems such as post-operative residual per-trochanteric pain, stiffness in muscles, and difficulty in climbing stairs are frequently mentioned (5-7). The weakness of the abductor muscles of the hip is the most important trigger of these problems. This weakness may occur due to direct damage of the muscle or damage to the superior gluteal nerve during antegrade nailing (8). Also, the pain in the lower limb is a significant predictor and source of disability (9).

The decrease in functional performance after femoral shaft fractures leads to an increase in the level of social dependence within society with a decrease in quality of life (10). Increased length of hospital stays, prolonged rehabilitation processes, and functional deficiencies may adversely affect the quality of life of the patients as well as socioeconomic problems such as professional education life or delay in return to work. However, it has been shown in previous studies that deep psychosocial influences were observed in individuals in the postoperative period (11). Decreases in the quality of life of individuals with FSF have been reported, even after an average of 55 months after surgery (7).

We hypothesized that the long-term functional outcomes and quality of life in young adults who underwent internal fixation surgery of isolated femoral shaft fracture would be not equal to their healthy peers. This study aimed to compare the long-term functional and quality of life outcomes of the young adults who underwent femoral nailing due to isolated femoral shaft fracture with their healthy peers.

METHODS

Sample Size and Participants

The effect size was calculated as 1.08 according to the data obtained from the pilot study (69.66±13.31, 85±14.93) since no similar studies were found in the literature in our study, in which the primary measurement parameter was determined as the total score of Harris Hip Score. According to these results, it was decided to include 20 individuals for each group in the study, according to the analysis made in the G*Power program, for the study to be 91.6% (alpha = 0.05, bidirectional) power. Twenty patients (15 male, 5 female) aged between 18-55 years who underwent internal fixation (IF) surgery participated. All the isolated fractures were fixed with intramedullary nails following either closed or open reduction in the supine position. Twenty healthy participants (15 male, 5 female) aged between 18-55 years were included in the study as a control group. Additional inclusion criteria were at least 1-year post-surgery and radiologically intact femoral shaft fracture. Individuals at risk for secondary osteoporosis, those who had neurological or systemic disease history, those who had undergone surgery for any pathology in the lower extremity, and those who had a revision or additional surgeries such as additional injuries, spinal column injury, tibia, humerus fractures, and subarachnoid bleeding due to FSF injury were excluded in the study.

Ethical approval was obtained from Hacettepe University Non-Interventional Clinical Research Ethics Committee with the number of GO 18/ 08-13. We carried out our studies on humans in ac-

cordance with the principles of the Declaration of Helsinki. This cross-sectional prospective study was conducted in the Department of Orthopedics and Traumatology of Hacettepe University Hospital, between 01.11.2018 - 01.07.2019. Before the procedure, participants were informed about the study, and an informed consent form was signed by all participants.

Procedure

Surgical procedures performed by an orthopedist with 20 years of surgery experience in Hacettepe University Hospital. During the hospitalization period after surgery, all patients received approximately 7-day inpatient physiotherapy program 2 times per day. This program included: Quadriceps isometric exercises, straight leg raises, and active-assistive and passive range of motion exercises. Partial weight-bearing as tolerated was started for all patients from the postoperative first day via crutches or walkers. Home exercises based on inpatient exercises were also advised to all patients before discharge. None of the patients received additional outpatient physical therapy. However, all patients were called for union and wound healing controls on their first week, 6th week, 3rd month, 6th month, and 1st year. Home exercises were also followed and developed by physiotherapists during these visits. Finally, all patients were contacted in for long-term assessments on average 2 years (18-36 months) following their surgery. All assessments are administered by a 5+ year experienced physiotherapist.

Functional Status Assessment

The pain and functional status of all individuals was assessed by the Harris Hip Score (HHS). The HHS is a valid and reliable questionnaire widely used to evaluate hip and related pathologies (12). It is a 10-item scoring including pain, function, functional activities, and joint range of motion. The severity of pain and its effect on activities were measured while scoring it. The HHS has a maximum score of 100 points. Higher scores indicate that lower risk of hip and related pathologies. Therefore, higher scores might be referred to as better functional outcomes following the interventions and surgeries (13,14). The Turkish version of the Harris Hip Score was used in our study. Turkish translation, validation, and cross-cultural adaptation has been performed by Çelik et al. in 2014 (15).

Functional performance was evaluated by the Stair Climb Test (SCT). The SCT is an easily accessible, convenient, and inexpensive test. It can be used to measure functional performance in neurological diseases, cardiovascular problems, post fractures, and musculoskeletal problems. There is no consensus on the number of steps to be used in the SCT (16). It is recommended in SCT that the step depth is 24-27 cm, and the step height is 16-20 cm (17). When performing the test, it was explained that the individual had to go up and down 9 steps. The step height of the stairs was 20 cm. The patients were asked to go up and down the steps one by one as quickly as possible. Before starting the test, an experiment was performed for the individual to fully understand the test. The patient was allowed to hold on to the handrail only to maintain balance, if possible. The patient was instructed to go up and down 9 steps with the start command, and this time was recorded in seconds.

Health-related Quality of Life Assessment

The quality of life was assessed by the EuroQol 5-Dimension Questionnaire (EQ-5D). The EQ-5D is a valid, reliable, standardized, and general health scale measuring health-related quality of life (HRQoL) (18). The EQ-5D is a scale with a wide perspective that can be used to measure the quality of life in many different disease groups, to determine cost-effectiveness analyses, or even to calculate quality-adjusted life expectancy (19). The scale consists of two parts. The first part, the EQ-5D index scale, consists of 5 dimensions including movement, self-care, usual activities, pain/discomfort, and anxiety/depression. Answers to each dimension have 3 options: no problem, some problem, and major problem. Index value results vary between “-0.59” and “1” points. In the index score function, the value of “0” indicates death, and the value of “1” the state of being completely healthy, while the negative values indicate the state of unconsciousness and bedridden life (20,21). Currently, there are more than 100 official language versions of EQ-5D including the Turkish version, which was obtained from EuroQol (www.euroqol.org) and applied to participants (22).

Legend of Figures

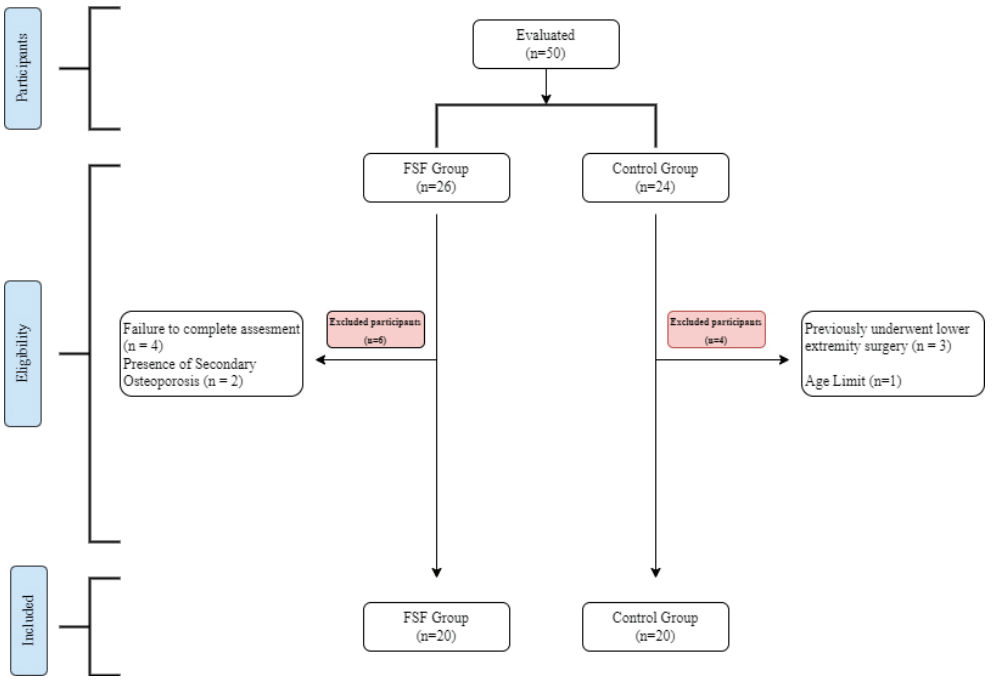

Figure 1. Flow chart of individuals included in the study

Statistical Analysis

Statistical analyses of the study were performed using the "Statistical Package for Social Sciences" (SPSS) version 22.0 (SPSS Inc. Chicago, IL, USA). Visual (probability plots and histograms) and analytical methods (Shapiro-Wilk's/ was performed to determine whether the selected parameters were normally distributed. The Mann-Whitney U-test was used for comparing nonparametric data in independent groups without normal distribution. The level of significance was set at $p<0.05$.

RESULTS

Fifty individuals were included at the beginning of the study. Ten individuals were excluded from the study for various reasons (Figure 1). A total of 40 individuals with "20" in the patient group (39.55±11.92 years) and "20" in the healthy control group (42.75±8.83 years) were included in the present study. The mean postoperative follow-up of the patients (n=20) was 28±7.22 (18-36) months. Their mean length of hospital stay after surgery was 7.35±3.49 (1-14) days.

The most common etiology of fracture was motor vehicle accidents (75%), followed by falls from height (10%), occupational injuries (10%), and firearm injuries (5%).

All the patients underwent antegrade intramedullary nailing in the supine position after closed (80%) or open (20%) reduction. Limb length inequality less than 2 cm was seen in 1 case (5%).

Table 1. Comparison of Physical Characteristics of the Participants

Physical Characteristics (n = 20)	FSF X ± SD	Control X ± SD	t	p
Age (years)	39.55 ± 11.92	42.75 ± 8.83	-0.964	0.43
Height (cm)	170.70 ± 8.51	170.15 ± 8.86	-0.200	0.86
Body weight (kg)	75.45 ± 12.68	74.01 ± 15.03	0.330	0.79
Body Mass Index (kg/m^2)	25.85 ± 3.76	25.40 ± 3.86	0.369	0.82

Independent Samples t-Test, **FSF:** Femoral Shaft Fracture Group, **X ± SD:** Mean ± Standard Deviation

Table 2. Comparison of Functional Performance and Quality of Life Results of Participants

(n=20)	FSF	Control		
	Min.-Max.	Min.-Max.	z	p
HHS	26.8-96.0	79-100	-4.959	<0.001**
SCT (sec)	4.01-29.82	4.20-7.71	-4.355	<0.001**
EQ-5D IS	0.125-0.774	0.596-1.0	-4.915	<0.001**

Mann-Whitney U Test, Min. – **Max**.: Minimum – Maximum, **FSF**: Femoral Shaft Fracture group, **HHS:** Harris Hip Score, **SCT:** Stair Climb Test, **EQ-5D IS:** EuroQol 5-Dimension Index Score

There was no statistically significant difference between the groups in terms of age, sex, height, body weight, and body mass index (p>0.05) (Table 1).

The mean HHS score was 71.65±15.42 in the FSF group, while the mean HHS score was 94.99±5.74 in the control group (p<0.001). For SCT scores, the FSF group (11.5 s) was approximately two times slower than the control group (5.5 s) (p<0.001). The EQ-5D outcomes of the FSF group were also significantly lower than the control group (p<0.001) (Table 2).

DISCUSSION

Functional disability in the early postoperative period is expected in patients with femoral shaft fractures. Our focus with the present study was to examine whether there are still functional deficits in patients in the long-term following union. The results of our study showed that the functional and quality of life outcomes of the individuals with FSF are lower than their healthy peers in the long term after IF surgery.

Evidently, FSF injuries predominantly manifest within the youth adults respectively to high-energy trauma, a trend substantiated by multiple studies with an age range of 30 to 40 years (23-25). Consistent with the studies, the present study has enrolled cases of a mean age of 39.

The incidence of femoral shaft fractures exhibits notable gender-based variations, with a higher prevalence observed among young adult males in comparison to females. In a study conducted by Sonbol et al., they reported a male-to-female ratio of 3.6:1 among the patients included in their investigation (24). Similarly, Elmi et al. indicated a study population distribution where 75% of participants were male and 25% were female. In the present study, it is found that male-to-female ratio of 3:1, which was comparable with literature findings (26).

The Harris Hip Score (HHS) is a frequently used assessment to measure both short- and long-term postoperative functional outcomes in femoral fractures. In the literature, a study in patients who underwent surgery for an intertrochanteric fracture reported a low HHS score in the short term after surgery (27,28). Similarly, in studies conducted in patients operated for proximal femur fracture, it was reported that the HHS score was moderate in the 1-year postoperative period (29,30).

Additionally, Moumni et al. reported that the moderate to severe pain persisted even 7 years after IF surgery after FSF in 17% of the patients and which might be critical source of functional disabilities (9).

Climbing stairs is an important functional performance that is widely used in daily life (31). To climb stairs, increased range of motion of joints and greater muscle strength in the lower extremities are needed. The SCT is an appropriate test of functional performance assessment since stair-climbing activities are both an important part of daily life and are related to independence and participation in society (32). Clinical studies have shown that individuals with osteoarthritis climbed stairs up and down for significantly longer time than individuals of the same age and sex both in the short and long term (17,33). Davis HC et al. demonstrated that lower percent fat mass and higher percent lean mass are individually associated with better physical performance (20-m fast-paced walk, 30-second chair-stand test, stair-climb test) in individuals with radiographic and symptomatic knee OA (33). There is a lack of studies assessing the ability to climb stairs after femoral shaft fracture patients. Our results also indicated disabilities in stair climbing activity in the long term after IF sur-

gery compared to healthy peers. Therefore, the functional performance of individuals with FSF in the short and long term should be monitored in routine clinical visits.

In short-term follow-up clinical studies evaluating the quality of life, it was found that quality of life was significantly lower in both geriatric and young adult populations in injuries such as unstable trochanter fracture and distal femoral fracture, compared to healthy individuals (34,35). Therefore, it is observed that the quality-of-life scores of individuals were lower than the norm values of the EQ-5D population in long-term follow-up studies (10). Ramoutar et al. evaluated young adult patients with proximal femoral fractures at least 2 years after surgery and found that the mean EQ-5D value was 0.70 (36). Larsen et al. reported that the mean value of EQ-5D was 0.79 in young adult patients, which they evaluated on average 55 months after FSF. In our study, the mean EQ-5D value of the patients with femoral shaft fractures was 0.52 and the mean EQ-5D value of the healthy individuals evaluated was 0.84. We think that the reason for some difference between the results of our study and the results of the studies of Ramoutar et al., and Larsen et al. is the difference in the norm values of the population in which the studies were conducted. However, we consider that this numerical difference can be explained by the facts that there is no norm value for the Turkish population in the EQ-5D scales formed by the EuroQol group and that Larsen et al. reported that the mean Danish index was 0.928 for males and 0.903 for females in their comparative study with the norm values of the Danish population (7). Even though the index scores may be different according to cultural norm values, it is reported that the long-term quality of life scores of our individuals with femoral shaft fractures were lower than their healthy peers in the present study.

This study has some limitations. Firstly, the present study did not measure the hip muscle strength of individuals with FSF. Hip muscle strength after surgery may be related to functional outcomes and quality of life. Further studies are necessary to determine whether individuals with FSF have long-term weakness in the hip and related muscles. Second, the preoperative status of functionality and quality of life of the patients could be obtained to compare long-term outcomes with healthy peers. Since the FSF requires immediate surgical intervention, the preoperative status of patients unable to be recorded. Lastly, the cross-sectional design of the present study limits the generalization of the obtained results.

We demonstrated that the individuals with FSF had lower functional outcomes and decreased quality of life even in the long term after internal fixation surgery. It is obvious that only achieving fracture union after surgery does not guarantee long-term better functional outcomes and quality of life. Therefore, the functional outcomes and quality of life assessments should be also on the agenda of health professionals both in the short and long term after surgery to develop better rehabilitation strategies for better outcomes in the FSF population.

Sources of Support:v There is no supporting organization.

Conflict of Interest: There is no conflict of interest.

Author Contributions: MTT; idea/concept, data collection and/or processing, analysis and/or interpretation literature review, article writing, CGA; analysis and/or interpretation, literature review, article writing, critical review. OC; idea/concept, design, supervision/consulting, critical review. GIK; idea/concept, design, supervision/consulting, materials, analysis and/or interpretation, critical review.

Explanations: 1. Muhammed Taha Tüfek, Gizem İrem Kınıklı. (2019) Femur cisim kırığına bağlı internal fiksasyon cerrahisi geçiren genç yetişkinlerde fonksiyonel sonuçlar ve yaşam kalitesinin incelenmesi. 7. Ulusal Fizyoterapi ve Rehabilitasyon Kongresi, Ankara. (Özet/Poster), Turkish Journal of Physiotherapy and Rehabilitation. 2. Muhammed Taha Tüfek, Gizem İrem Kınıklı (2021) Femur cisim kırığına bağlı internal fiksasyon cerrahisi geçiren genç yetişkinlerde fonksiyonel sonuçlar ve yaşam kalitesi arasındaki ilişkinin incelenmesi. 8. Ulusal Fizyoterapi ve Rehabilitasyon Kongresi. (Özet/Sözel Bildiri), Turkish Journal of Physiotherapy and Rehabilitation.

Acknowledgment: We would like to thank all patients who actively participated in this study.

REFERENCES

1. Denisiuk M, Afsari A. Femoral shaft fractures. Treasure Island (FL): StatPearls Publishing; 2023.
2. Trompeter A, Newman K. Femoral shaft fractures in adults. Orthopaedics and Trauma, 2013;27(5):322-331.
3. de Moraes FB, da Silva LL, Ferreira FV, Ferro AM, da Rocha VL, Teixeira KI. Epidemiological and radiological evaluation of femoral shaft fractures: Study of 200 cases. Rev Bras Ortop. 2015;44(3):199-203.
4. Bekos A, Sioutis S, Kostroglou A, Saranteas T, Mavrogenis AF. The history of intramedullary nailing. Int Orthop. 2021;45(5):1355-61.
5. Hussain N, Hussain FN, Sermer C, Kamdar H, Schemitsch EH, Sternheim A et al. Antegrade versus retrograde nailing techniques and trochanteric versus piriformis intramedullary nailing entry points for femoral shaft fractures: a systematic review and meta-analysis. Can J Surg. 2017;60(1):19-29.
6. Mansouri-Tehrani MM, Yavari P, Moosayii D, Eslami S, Nourian SMA. Evaluation of femoral malrotation after intramedullary nailing. Int J Burns Trauma. 2021;11(5):418-423.
7. Larsen P, Elsoe R, Graven-Nielsen T, Laessoe U, Rasmussen S. Decreased muscle strength is associated with impaired long-term functional outcome after intramedullary nailing of femoral shaft fracture. Eur J Trauma Emerg Surg. 2015;41(6):673-81.
8. Ahmed MA, Khalifa AA. Hip Abductor Muscle Weakness after Antegrade Nailing of Femoral Fractures. Int J Ortho Res.2020;12:241-248.
9. el Moumni M, Voogd EH, ten Duis HJ, Wendt KW. Long-term functional outcome following intramedullary nailing of femoral shaft fractures. Injury. 2012;43(7):1154-8.
10. Ekström W, Németh G, Samnegård E, Dalen N, Tidermark J. Quality of life after a subtrochanteric fracture: a prospective cohort study on 87 elderly patients. Injury. 2009;40(4):371-6.
11. Lerner RK, Esterhai JJ, Polomano RC, Cheatle MD, Heppenstall RB. Quality of life assessment of patients with posttraumatic fracture nonunion, chronic refractory osteomyelitis, and lower-extremity amputation. Clin Orthop Relat Res. 1993;(295):28-36.
12. Lee SY, Park SJ, Gim JA, Kang Y, Choi AH, Seo SH, et al. Correlation between Harris hip score and gait analysis through artificial intelligence pose estimation in patients after total hip arthroplasty. Asian J Surg. 2023;S1015-9584(23)00778-9.
13. Aprato A, Secco DC, D'Amelio A, Grosso E, Massè A. Nailing femoral shaft fracture with postless distraction technique: a new technique enabled by shape-conforming pad. J Orthop Traumatol. 2021;22(1):14.
14. Hersnaes PN, Gromov K, Otte KS, Gebuhr PH, Troelsen A. Harris Hip Score and SF-36 following metal-on-metal total hip arthroplasty and hip resurfacing - a randomized controlled trial with 5-years follow up including 75 patients. BMC Musculoskelet Disord. 2021;22(1):781.
15. Çelik D, Can C, Aslan Y, Ceylan HH, Bilsel K, Ozdincler AR. Translation, cross-cultural adaptation, and validation of the Turkish version of the Harris Hip Score. Hip Int. 2014;24(5):473-9.
16. Nightingale EJ, Pourkazemi F, Hiller CE. Systematic review of timed stair tests. J Rehabil Res Dev. 2014;51(3):335-50.
17. Onodera CMK, Coelho-Júnior HJ, Sampaio RAC, Santos Duarte Lana JF, Teixeira LFM, Uchida MC, et al. The importance of objectively measuring functional tests in complement to self-report assessments in patients with knee osteoarthritis. Gait Posture. 2020;82:33-7.
18. Parsons N, Griffin XL, Achten J, Costa ML. Outcome assessment after hip fracture: is EQ-5D the answer? Bone Joint Res. 2014;3(3):69-75.
19. Olerud P, Tidermark J, Ponzer S, Ahrengart L, Bergström G. Responsiveness of the EQ-5D in patients with proximal humeral fractures. J Shoulder Elbow Surg. 2011;20(8):1200-6.
20. Çetin A, Ozdemir O, Haghari FS, Taşoğlu. The impact of physical therapy programs on pain and quality of life. Turk J Phys Med Rehabil. 2012;58(2).
21. Ergul M, Moghadam AN, Bıglarıan A. Effects of static and functional stretching exercises on lower limb spasticity and function in people with multiple sclerosis: a randomized controlled trial. Turk J Physiother Rehabil. 2021;32(3):43-51.
22. EQ-5D [Internet]. Available from: https://euroqol.org/eq-5d-instruments/all-eq-5d-versions/.
23. Ugezu A, Nze I, Ihegihu C, Chukwuka N, Ndukwu C, Ofiaeli R. Management of femoral shaft fractures in a tertiary centre, south east Nigeria. Afrimedic Journal. 2018;6(1):27-34.
24. Sonbol AM, Almulla AA, Hetaimish BM, Taha WS, Mohmmedthani TS, Alfraidi TA, et al. Prevalence of femoral shaft fractures and associated injuries among adults after road traffic accidents in a Saudi Arabian trauma center. JMSR. 2018;2(2):62.
25. Sarraj TS, Shah JZ. Distal femoral shaft fractures. Professional Med. J. 2018;25(3):359-63.
26. Elmi A, Rohani AR, Tabrizi A, Esmaili SM. Comparison of outcome of femoral shaft fracture fixation with intramedullary nail in elderly patient and patients younger than 60 years old. Arch Bone Jt Surg. 2014;2(2):103-105.
27. Loh J, Huang D, Lei J, Yeo W, Wong MK. Early clinical outcomes of short versus long proximal femoral nail anti-rotation (pfna) in the treatment of intertrochanteric fractures. Malays Orthop J. 2021;15(2):115-121.
28. Nilsdotter A, Bremander A. Measures of hip function and symptoms: Harris Hip Score (HHS), Hip Disability and Osteoarthritis Outcome Score (HOOS), Oxford Hip Score (OHS), Lequesne Index of Severity for Osteoarthritis of the Hip (LISOH), and American Academy of Orthopedic Surgeons (AAOS) Hip and Knee Questionnaire. Arthritis Care Res. 2011;63:S200-S207.
29. Aygun U, Ayık O. Functional results of patients with femoral intertrochanteric fractures who underwent surgery of proximal femoral nail or bipolar hemiarthroplasty – a comparative study. Ann. Med. Res. 2023;30(1)58-64.
30. Devarshi R, Shailendra S, Ahmad O, Shah W, Kumar SS, Nath R. Total hip arthroplasty for failed osteosynthesis of proximal femoral fractures: Clinical outcomes from a low- and middle-income country. J. Arthrosc. Jt. Surg. 2022;9(1):22-27.
31. Brand A, von Rüden C, Probst C, Wenzel L, Augat P, Perl M. Early biomechanical outcome in patients with acetabular fractures treated using the pararectus approach: a gait and stair climb analysis study. Eur J Trauma Emerg Surg. 2022;48(2):1307-1316.
32. Almeida GPL, Monteiro IO, Dantas RGO, Tavares MLA, Lima POP. Reliability, validity and responsiveness of the Step Up and Down (StUD) test for individuals with symptomatic knee osteoarthritis. Musculoskelet Sci Pract. 2021;56:102454.
33. Davis HC, Blue MNM, Hirsch KR, Luc-Harkey BA, Anderson KC, Smith-Ryan AE, et al. Body composition is associated with physical performance in individuals with knee osteoarthritis. J Clin Rheumatol. 2020;26(3):109-14.
34. Fernandez M, David Y, Dubrana F, Di Francia R. Use of a trochanteric fixation nail-advanced (TFNA) with cement augmentation for treatment of trochanteric fractures in patients greater than sixty five years of age. Int Orthop. 2022;46(3):645-51.
35. Pan Z, Jiang P, Zhao Y, Xue S, Gao P. Ipsilateral distal third femoral shaft fracture and retrograde intramedullary fixation are not absolute contraindications to anterolateral thigh flap harvest: A case report. JPRAS Open. 2021;31:99-104.
36. Ramoutar D, Kodumuri P, Rodrigues J, Olewicz S, Moran C, Ollivere B, et al. The epidemiology and functional outcomes of operative fixation of extracapsular proximal femoral fractures (AO 31-A) in young adults. Eur J Orthop Surg Traumatol. 2017;27(2):267-72.