Intramedullary Nailing of Femoral Shaft Fractures Patients: Impact of Nursing Rehabilitation Protocol on Complications and Lower Extremity Function

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Abstract:

Background: Intramedullary nailing is a common method of treatment for femoral shaft fractures. **Aim:** To evaluate impact of nursing rehabilitation protocol on complications and lower extremity function of intramedullary nailing of femoral shaft fractures patients. **Research design:** quasi-experimental research design. **Setting:** Trauma unit and orthopedic outpatient clinics at Assiut University Hospital. **Sample:** A convenient sample of one hundred patients aged 18–75 years old and from both sexes with intramedullary nails was divided into two equal groups (50 for each group). **Tools: I,** "A structured interview-based femoral shaft intramedullary nailing questionnaire," **II,** "Postoperative complications assessment questionnaire following femoral intramedullary nailing surgery," and **III,** "Lower Extremity Functional Scale." **Results:** There was a statistically significant difference between the study and the control group regarding the occurrence of some complications and the total mean score of the lower extremity functional scale during follow up periods after application of the nursing rehabilitation protocol post-intramedullary nailing (p-value = 0.001**, 0.005**, respectively). **Conclusion:** Nursing rehabilitation protocol has a positive effect on reducing complications and improving lower extremity function after intramedullary nailing**. Recommendations:** Rehabilitation protocol is recommended to be an integral part of the preoperative nursing teaching for patients undergoing intramedullary nailing surgery, and a booklet should be available at the trauma unit and orthopedic outpatient clinic as a reference.

Keywords: Complications, Intramedullary Nailing, Lower Extremity Function, Rehabilitation.

Introduction

The human femur is the longest, heaviest, and strongest tubular bone. One of the most frequent fractures seen in rehabilitation settings are femoral shaft fractures. A significant issue for patients with femoral shaft fractures is long-term impairment. Age-related fractures of the femoral shaft have a bimodal distribution. High-energy injuries in young men or low-energy injuries such as those in elderly women are the cause of these fractures (**Mohammad, 2020).** Fractures of the femoral shaft are linked to functional restrictions and impairments that are caused by soft tissue damage from trauma during an accident, surgery, or both. Among these limitations are weakness in the hip abductors, weakness in the quadriceps, limited hip mobility, knee discomfort, and decreased walking endurance. Early patient mobility, reduced pain, minimized joint stiffness, and early functional recovery are all made possible by surgical treatment. Early weight bearing following surgery has been recommended as a way to reduce hospital stays, speed up the healing of fractures, and save healthcare expenditures. The long-term effects of vigorous physical therapy may result in functional

impairments and disability **(Denisiuk and Afsari, 2022)**.

An intramedullary nail is a metal rod that is placed across a fracture and into the medullary cavity of a bone to give the damaged bone strong support. Treatment for femoral shaft fractures now often involves intramedullary nailing. The intramedullary nailing treatment requires shorter hospitalization, early recovery, and a lower risk of problems. Early weight bearing and strengthening of the hip and knee muscles are key components of a rehabilitation program that can help promote positive results and an early return to function. However, the only remaining loss in cases of femoral shaft fractures is a limp during walking **(Singhal, 2020).**

Patients, particularly the elderly, require perioperative nursing care that is unique and difficult because of the deterioration of their own organ function, which is typically accompanied by another underlying disease. In elderly people, femur fractures are frequently linked to severe osteoporosis and other medical conditions. Because of the elderly population's higher bony curvatures, deteriorating bone quality, and reduced rehabilitation compliance, these issues are exacerbated **(Yoon et al., 2022).**

There are various common surgical treatments, but the surgical treatment of intramedullary fixation is currently more common because it can reduce surgical trauma, reduce complications, obtain a good fixation, benefit early functional exercise, and have other advantages. It also does not require peeling the soft tissue of the fracture due to the surgical treatment. Because of this, the management of intertrochanteric fracture surgery depends not only on cutting-edge technology but also on thorough, well-reasoned, and efficient nursing intervention for the operation's success and the avoidance of complications **(Fischer et al., 2021).**

Among the pertinent rehabilitation experts is a rehabilitation nurse. The goal of rehabilitation is to keep people functioning better. Exercises for rehabilitation are essential to pre- and post-surgical care. In the context of rehabilitation, nurses have a proactive role in attending to patients' fundamental needs, promoting their functional capacities, and supporting them as they take precautions against harm in their daily lives. Rehabilitation nurses assess patients' needs for care and offer guidance and assistance. Give them instructions for a home workout regimen to increase their femur strength and endurance **(Gutenbrunner et al., 2021).**

Significance of the study:

Femoral shaft fractures occur in between 10 and 21 out of every 100,000 people worldwide each year. There are two percent of these fractures that are open. According to the American Society for Bone and Mineral Research (ASBMR), the incidence of atypical femur fractures varies from 3.5% to 16%. Fractures are more common in men between the ages of 15 and 35, whereas in women, the risk starts to rise steadily at age 60. Ground-level falls are more likely to result in a fracture for women. Younger people are more likely to be involved in car accidents, but older people are more likely to experience ground-level falls, which are linked to osteoporosis. The elderly are the primary population affected by proximal femur fractures. Remarkably, the age **(Denisiuk and Afsari, 2022).**

One of the most common fractures affecting the lower limbs, femur shaft fractures can cause severe pain, bleeding, and hospitalization. The survivors may become permanently disabled as a result of these injuries. Reduced impairment, lower disability, and improved functional results may arise from early rehabilitation after surgical stabilization of a mid-shaft femoral fracture, with an emphasis on early weight bearing, strengthening of the quadriceps and hip abductors, and knee range of motion (ROM). Intramedullary nailing produces a comparatively short total disability time and a quick recovery of motion in all joints after a short period of hospital stay **(Yoon and Liporace, 2018).** Therefore, nursing rehabilitation protocol is a major factor in the success of intramedullary nailing as well as

reducing the incidence of complications post-surgery.

Aim of the study:

To evaluate the impact of nursing rehabilitation protocol on complications and lower extremity function of intramedullary nailing of femoral shaft fractures patients.

Research hypothesis:

The hypothesis to be tested in this study is:

- H1: The nursing rehabilitation protocol will have a positive effect on reducing postoperative patients' complications and improving lower extremity function.

Null Hypothesis:

- H1: The nursing rehabilitation protocol will exhibit no prevention of postoperative patients' complications or improvement of lower extremity function.

Methods:

Research design:

A quasi-experimental research design was utilized in this study (study and control group) and was adopted **(Lauren, 2022).**

Setting:

This study was carried out at Assiut University Hospital's trauma unit. The trauma unit consists of one floor, which consists of ten rooms. Each room has eight beds, and there is a nursing room on this floor. Then, both male and female follow up was done in the orthopedic outpatient clinics.

Study participants and prerequisites:

A convenience sampling of 100 patients with femoral shaft fractures who undergo femoral intramedullary nailing surgery from both sexes was selected and randomly divided into two equal groups (50 patients for each group): Study group who received the designed nursing rehabilitation protocol in addition to regular hospital routine care and control group who received regular hospital routine care only.

Exclusion criteria:

Patients with peripheral neurological problems, comatose patients and patients with vascular diseases.

Sampling technique:

Sample size was calculated according the total number of femoral intramedullary nail patients admitted Trauma unit at Assuit University Hospital was around 130 cases in 2021. By using software EPI/ info version 3.3 with confidence interval 95%, it estimated to be 98+ 2 to avoid drop out. The total number of sample 100 patients were enrolled in the study and divided into two equal groups: study and control groups, 50 patients for each group. The randomization sequence, using a restricted randomization scheme to assure equal numbers in each group.

Tools of the study: -

Tool (I): A structured interview-based femoral shaft intramedullary nailing questionnaire: It was developed by the researchers based on literature review to assess patient's health history. It included the following:

Part 1: Patient's personal data: to assess the patients' personal data. It included age, sex, residence, educational level, occupation, and length of hospital stay.

Part (2): Patient`s health data: It included medical data on such comorbid conditions as diabetes, hypertension, asthma, coronary heart disease, and cancer, as well as surgical history and cause of injury.

Tool II: Postoperative complications assessment questionnaire following femoral intramedullary nailing surgery: It was developed by the researchers after an extensive review of recent and relevant literature **(Auston et al., 2018)** to assess the patient's complications following femoral intramedullary

nailing surgery two weeks later, one month later, and six months postoperatively.

- Is a questionnaire containing 14 questions about post-operative complications. Each question resembles a complication.

- Post-operative complications, e.g., compartment syndrome of the thigh, vascular injuries, swelling and wound-healing problems, infection, deep vein thrombosis, pulmonary embolism, nerve palsy, limb shortening, post-traumatic arthritis, knee stiffness, malunion, nonunion, heterotopic ossification, and soft tissue irritation at the entry point.

- **Scoring system:** the researchers assess patients about the occurrence of a complication through 14 questions (yes or no questions). Occurrence of complications = yes. No complications = no. then the numbers and percentages of occurrence of post-operative complications calculated by Cochran`s Q test.

Tool III: Lower Extremity Functional Scale (LEFS) (adopted from Binkley et al.,1999): Is a valid and reliable patient-rated outcome measure for the measurement of lower extremity function with excellent internal reliability ($\alpha = 0.94$). It was applied two weeks, one month, and six months postoperatively to the nursing rehabilitation protocol.

- Is a scale containing 20 questions about a person's ability to perform everyday tasks. The LEFS can be used by clinicians as a measure of patients' initial function, ongoing progress, and outcome, as well as to set functional goals.

- The LEFS can be used to evaluate the functional impairment of a patient with a disorder of one or both lower extremities. It can be used to monitor the patient over time and to evaluate the effectiveness of an intervention.

- Patients select an answer from the following scale for each activity listed:

1.Extreme Difficulty or Unable to Perform Activity (0)

2.Quite a Bit of Difficulty (1)

3.Moderate Difficulty (2)

4.A Little Bit of Difficulty (3)

5.No Difficulty (4)

LEFS scoring system: The columns on the scale are summed to get a total score (points for all 20 activities).

- The maximum possible score is 80 points, indicating very high function.

- The score of 0–20 indicates severe functional limitation.

- 21–40 moderate functional limitations.

- 41–60 mild functional limitation.

- 61–80 minimal functional limitation or normal function.

Procedure:

Phase I: Assessment and planning phase:

- Development of the study tools: Tools (I and II) and the nursing rehabilitation protocol was written in Arabic based on determined needs, baseline measures, and relevant literature. It was supplemented with simple words and accurate pictures to help them retain the learned material for patients with learning difficulties.

- Teaching methods: booklet handouts, PowerPoint, and videos on mobile. Also, the researchers used simple pictures and diagrams.

- Validity testing: Five specialists were shown data collection tools in the Medical, Surgical nursing, and Gerontological nursing departments at the Faculty of Nursing to evaluate the validity of the content.

- The reliability of the tools was tested by means of Cronbach's alpha. The reliability coefficient for tool I was.871, tool II was.989, and tool III was 94, which means all tools were reliable.

- A pilot study was done using 10% of the total sample size (10 patients) to examine

the tools' feasibility and applicability, as well as the time necessary to complete them.

- **Data collection** was carried out from June 2022 to September 2023. The nursing rehabilitation protocol for patients who had femoral shaft fractures was conducted with the study group subjects throughout four phases.

Ethical Considerations:

The research proposal was approved by the ethical committee in the faculty of nursing at Assuit University (4-2022). There was no risk to the study subject during the application of the study. The study followed common ethical principles in clinical research. Informed consent was obtained from the patients who were willing to participate in the study after explaining the nature and purpose of the study. Confidentiality and anonymity were assured. The studied subject had the right to refuse to participate or withdraw from the study without reason at any time. Patient privacy was considered during the collection of data.

Phase II: Implementation phase:

- On admission, the researchers met with patients individually, built therapeutic communication, and obtained consent for voluntary participation in the study from the patient to get their cooperation after explaining the purpose of the study.

- On the first day of the interview, preoperatively prior to the start of the nursing rehabilitation protocol, all patients (study and control group) were assessed using tool I to gather personal and health data.

- The researchers collected data from the study group who were subjected to the nursing rehabilitation protocol scheduled for five sessions: educational and practical sessions. The duration of each session was about 35–40 minutes. All sessions were done preoperatively after filling all tools.

- Sessions of data collection were carried out in the trauma unit at Assuit University Hospital.

- Researchers also kept in contact with the studied patients via a smartphone as a reminder throughout the protocol and to increase adherence.

- In the first session, the researcher explained to the patient in a simple note the anatomy of the femur, hip, and knee joints, the definition of femoral shaft fracture, the cause of injury, signs and symptoms, as well as knowledge related to intramedullary nailing, its meaning, pre-surgery instructions, day surgery instructions, post-surgery instructions, and follow up instructions. One family member was present in the session for patient support and to increase their sense of responsibility. Patients could ask questions in case of misunderstanding while listening and expressing interest.

- The remaining four practical sessions contained training on the basic rehabilitation exercises. The nursing rehabilitation protocol is designed to guide patients through the next few months with some simple exercises to gradually reduce pain and swelling, improve range of motion and muscle strength, steadily improve femur function, and enable patients to carry out the activities of daily living independently, as demonstrated by the researchers to the patient. The caregiver was recommended to help the patient apply these exercises at home after surgery.

The nursing rehabilitation exercises are classified into four phases:

- **Phase I**: immediate post-operation exercise started from 1-2 weeks after surgery (feet and ankle exercises, leg extension exercise with knee pressure down, the exercise of raising the leg from the supine position, exercise pulling the heel of the leg up towards the body, knee straightening exercise towards the affected thigh using the healthy foot, knee flexion exercise with the help of a healthy foot, flexion of the affected foot to the level of the healthy foot, quadriceps stretching exercise, and knee movement exercise). Repeat this exercise 10 times daily for a period ranging from 2 to 3 times.

- **Phase II**: started from 3-6 weeks after surgery: Knee hanging exercise, standing knee

bend exercise, hamstring and hip strengthening exercise, pelvic raise exercise, exercise to join the thighs inside and outside, and heel-raise exercise. Maintain this position for 20–30 seconds, and repeat the exercise five times daily.

- **Phase III:** started 7–12 weeks late post-operatively (stationary bike exercise, partial seated position exercise with the back against the wall). Maintain this position for 3 seconds and repeat the exercise five times daily.

- **Phase IV:** started from 4-6 months after surgery (stair climbing exercises, riding a bicycle outside the home, running exercises, and jumping exercises). Maintain this position for 10 seconds and repeat the exercise five times daily.

- During each session, the researcher used simple, brief, and clear words and photos. At the end of each session, a brief summary was given by the researcher, emphasizing the importance of follow-up visits and arranging with them the time and place for follow up. Moreover, the colored booklet was given to each patient in the study group to attract his or her attention, motivate and help in reviewing, and support teaching at home.
- After completing each session, there were about 5–10 minutes for discussion and feedback.
- The researchers visited the patient of the study group in the hospital to encourage and observe him to understand and apply rehabilitation exercises. The patient's stay in the hospital after surgery ranged from 7 to 10 days, depending on the patient's condition.

Phase III: Evaluation phase:

The last phase of the nursing rehabilitation protocol is the evaluation phase. In which the patients were evaluated three times (after two weeks, two months, and then six months postoperatively) in the orthopedic outpatients' clinic at Main Assuit University Hospital for reevaluating postoperative patients' complications and lower extremity function for both control and study groups by using tools II and III.

- Also, telephone follow-up and using social media websites such as WhatsApp were conducted for the study group to evaluate their adherence skills and their condition.

Statistical analysis:

Categorical variables were described by number and percent (N, %), while continuous variables were described by the mean and standard deviation (Mean, SD). The chi-square test is used to compare categorical variables between continuous variables by t-test. Cochran's Q test was used to show the relationship between variables. A paired samples test was used to compare the mean. A P-value is considered statistically significant when $p < 0.05$. Person correlations are used to indicate the association between scores. All analyses were performed with the IBM SPSS 26 software.

Results

Table 1 shows the personal data of 100 patients who met the inclusion criteria. Mean ± SD age of 50.42±13.68 years in the study group and 51.18±13.46 years in the control group ($P = 0.821$). In the study group, there were 56.0% male and 44.0% female patients. In the control group, there were 46.0% male and 54.0% female patients. In terms of residence, the table revealed that the majority of patients (64.0% and 54.0%, 54.0 % respectively) in both groups (study and control) lived in rural areas. Regarding education, it was found that the highest percentage of patients (34.0% and 36.0%, respectively) in both groups (study and control) had high education but were illiterate (32.0%) in the study and control groups. The highest percentages (52.0%, 68.0%) in both groups were working. With respect to the demographic characteristics of the two groups, it was found that there were no significant differences between them ($p > 0.05$).

Figure 1 Reveals that for the highest percentage of the studied patients in both the study and control groups (78% and 62%, respectively), their length of hospital stay ranged from 5 to less than 10 days. A highly significant difference was detected in the length

of hospital stay between the two groups, as presented by the P value (0.002*).

Table 2 shows that the majority of the studied sample in both the study and control groups don't have a surgical history (74 and 62%, respectively). According to medical history (42 and 40%, respectively), diabetes was present in both the study and control groups.

Figure 2 shows that the cause of injury was not significantly different between both groups and that the most frequent cause of fracture was a fall (58% in the study group and 68% in the control group).

Table 3 shows that there was a highly statistically significant difference regarding the occurrence of some complications in the two groups throughout the phases of follow-up duration post-rehabilitation protocol as regards vascular injuries, swelling and wound-healing problems, infections, malunion, non-union, and soft tissue irritation at the entry point (P value = 0.001**). And there was a statistically significant difference regarding deep vein thrombosis (p value = 0.038*) and knee stiffness (p value = 0.008**).

Table 4 summarizes that there was a highly statistically significant difference between the study and control groups regarding the total mean± SD of the lower extremity functional scale throughout the phases of follow-up duration (P-value 0.005**).

Table 5 illustrates that there was a significant positive correlation between the total lower extremity functional scoring scale and the personal data of the two groups as regards age groups, gender, educational level, and occupation post-rehabilitation protocol (p values =.0001,.0001,.003,.016,.003,.041, and.003, respectively).

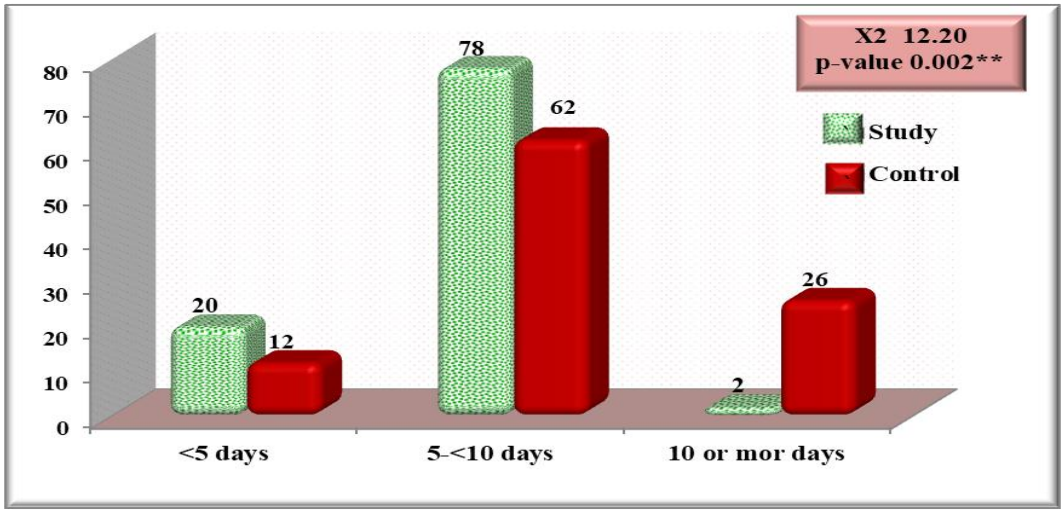
Table 6 summarizes that there was a significant positive correlation between the total lower extremity functional scoring scale and the occurrence of some complications in the two groups throughout the phases of follow-up duration and post-rehabilitation protocol as regards swelling and wound-healing problems, infections, malunion, and soft tissue irritation at the entry point.

Table (1): The frequency and percentage distribution of the studied patients according to their personal data in both groups.

Personal data	Study group N=(50)		Control group N=(50)		X^2	P-value
	N.	%	N.	%		
Age/years:						
• < 40 years	14	28.0	13	26.0		
• 40 - 60years	12	24.0	10	20.0	**0.395**	**0.821**
• >60 years	24	48.0	27	54.0		
Mean±SD	50.42±13.68		51.18±13.46			
Sex:						
• Male	28	56.0	23	46.0	**1.00**	**0.317**
• Female	22	44.0	27	54.0		
Residence:						
• Urban	18	36.0	23	46.0	**1.03**	**0.309**
• Rural	32	64.0	27	54.0		
Educational level						
• High education	17	34.0	18	36.0		
• Secondary school	9	18.0	12	24.0	**1.79**	**0.617**
• Read and write	8	16.0	4	8.0		
• Illiterate	16	32.0	16	32.0		
Occupation						
• Working	26	52.0	34	68.0	**2.67**	**0.102**
• Not working	24	48.0	16	32.0		

Chi square test Significant at P. values ≤ 0.05

Figure (1): Comparison between the two groups as regards length of hospital stay (days). (N=100)



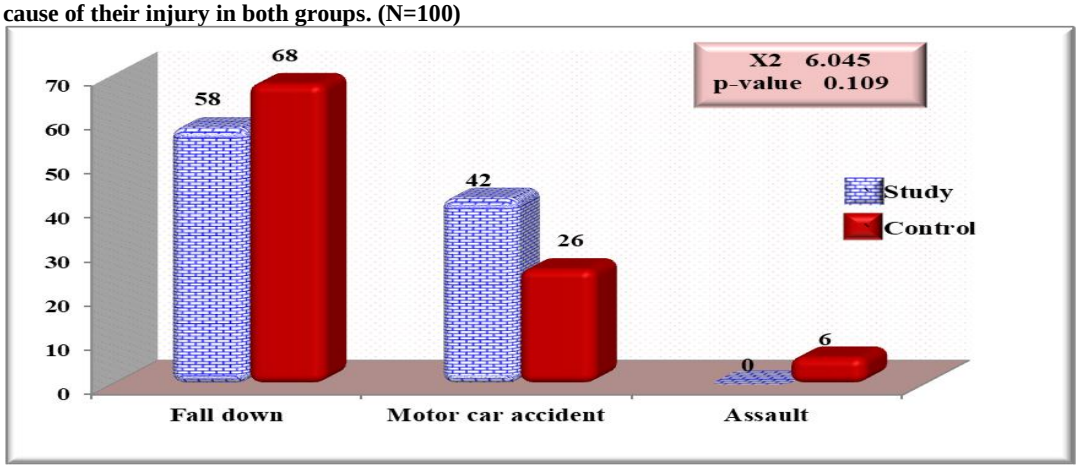
Chi square test (**) Highly statistically significant difference

Table (2): The frequency and percentage distribution of the studied patient according to their health data in both groups.

Medical data	Study group N=(50)		Control group N=(50)		X^2	P-value
	N	%	N	%		
Medical history						
• Diabetes	21	42	20	40		
• Hypertension	10	20	9	18		
• Asthma	8	16	9	18	**0.124**	**0.955**
• Coronary heart disease	9	18	11	22		
Cancer	2	4	1	2		
Surgical History:						
• Yes	13	26.0	19	38.0	**1.142**	**0.288**
• No	37	74.0	31	62.0		

Chi square test Significant at P. values ≤ 0.05

Figure (2): The frequency and percentage distribution of the studied patients according to the cause of their injury in both groups. (N=100)



Chi square test (**) Highly statistically significant difference

Table (3): The frequency and percentage distribution of the occurrence of complications in both groups throughout the phases of the follow-up duration.

Complications	Study group N=(50)			Control group N=(50)			p-value
	After 2wks	After1 month	After 6 months	After 2wks	After1 month	After 6 months	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Compartment syndrome	0(0.0)	1(2.0)	0(0.0)	0(0.0)	1(2.0)	0(0.0)	**0.392**
Vascular injuries	0(0.0)	1(2.0)	2(4.0)	10(20.0)	6(12.0)	5(10.0)	**0.001****
Swelling and wound-healing problems	5(10.0)	12(24.0)	8(16.0)	35(70.0)	35(70.0)	34(68.0)	**0.001****
Infections	4(8.0)	13(26.0)	5(10.0)	38(76.0)	41(82.0)	35(70.0)	**0.001****
Deep vein thrombosis	1(2.0)	1(2.0)	1(2.0)	2(4.0)	3(6.0)	4(8.0)	**0. 038***
Pulmonary embolism	0(0.0)	0(0.0)	0(0.0)	1(2.0)	1(2.0)	0(0.0)	**0.572**
Nerve palsy	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(2.0)	1(2.0)	**0.392**
Limb shortening	1(2.0)	1(2.0)	0(0.0)	2(4.0)	3(6.0)	2(4.0)	**0.066**
Post-traumatic arthritis	0(0.0)	0(0.0)	0(0.0)	1(2.0)	1(2.0)	1(2.0)	**0.392**
Knee stiffness	0(0.0)	1(2.0)	0(0.0)	5(10.0)	4(8.0)	7(14.0)	**0.008****
Malunion	1(2.0)	6(12.0)	1(2.0)	12(24.0)	17(34.0)	17(34.0)	**0.001****
Non union	0(0.0)	0(0.0)	0(0.0)	9(18.0)	13(26.0)	12(24.0)	**0.001****
Heterotopic ossification	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(2.0)	1(2.0)	**0.392**
Soft tissue irritation at the entry point	6(12.0)	11(22.0)	4(8.0)	12(24.0)	14(28.0)	15(30.0)	**0.001****

Cochran's Q Test (*) Statistical significant difference (**) Highly statistical significant difference

Table (4): Comparison between the two studied groups according to total mean and SD of the lower extremity functional scale throughout the phases of follow up duration.

Phases of Follow up duration	Study group N=(50)	Control group N=(50)	p-value
	Mean ±SD	Mean ±SD	
▪ 2 weeks after operation	13.38±8.25	1.24±3.91	**0.001****
▪ 1 month after operation	32.02±10.52	6.48±6.89	**0.001****
▪ 6 months after operation	51.40±11.93	13.16±8.85	**0.001****
Total mean± SD	96.80±30.06	20.88±16.62	**0.005****

Paired Samples Test (*) Statistical significant difference (**) Highly statistical significant difference

Table (5) Correlation between the total lower extremity functional scale and the personal data of the two groups post rehabilitation protocol.

Personal data	Total lower extremity functional scale		
		Study group N=(50)	Control group N=(50)
Age/years	Pearson Correlation	**.543****	**.646****
	Sig. (2-tailed)	.0001	.0001
Gender	Pearson Correlation	**.527****	**.417****
	Sig. (2-tailed)	.0001	.003
Residence	Pearson Correlation	**.331***	.138
	Sig. (2-tailed)	.019	.338
Educational level	Pearson Correlation	**.338***	**.417****
	Sig. (2-tailed)	.016	.003
Occupation	Pearson Correlation	**.290***	**.417****
	Sig. (2-tailed)	.041	.003

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Table (6) Correlation between the lower extremity functional scale and the occurrence of complications in both groups throughout the phases of follow-up duration post rehabilitation protocol.

Complications		Total lower extremity functional scale					
		Study group N=(50)			Control group N=(50)		
		After 2wks	After1 month	After 6 months	After 2wks	After1 month	After 6 months
Swelling and wound-healing problems	Pearson Correlation	**.390****	.246	.184	.183	**.374****	**.396****
	Sig. (2-tailed)	**.005**	.084	.201	.205	**.008**	**.004**
Infections	Pearson Correlation	.236	**.352***	**.423****	.078	.181	**.472****
	Sig. (2-tailed)	.099	**.012**	**.002**	.590	.209	**.001**
Deep vein thrombosis	Pearson Correlation	.138	.138	.138	.076	.049	.042
	Sig. (2-tailed)	.338	.338	.338	.600	.734	.770
Mal union	Pearson Correlation	**.282***	.022	**.282***	.064	.154	.149
	Sig. (2-tailed)	**.047**	.878	**.047**	.659	.285	.302
Soft tissue irritation at the entry point	Pearson Correlation	.260	**.298***	.082	.078	.055	.146
	Sig. (2-tailed)	.068	**.035**	.570	.588	.704	.310

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

Discussion

Femur fractures (FF) are frequent injuries that occur from high-energy processes, primarily falls from heights and motor vehicle collisions (MVCs). One of the primary techniques for treating fractures is intramedullary nailing. One well-known technique for surgically stabilizing bone fragments is intramedullary nailing. Currently, the gold standard for treating femoral shaft fractures is intramedullary nailing. According to recent research, a sizable group of individuals who had their femur fractures treated with an intramedullary nail may experience long-term residual impairments and eventually disabilities after the procedure (**Swentik et al., 2018).**

The present study investigated the impact of nursing rehabilitation protocol on complications and lower extremity function after intramedullary nailing of femoral shaft fractures.

The results of the present study revealed that most of the studied patients were older than 50 years. This outcome could be explained by the fact that intramedullary nailing of femoral shaft fractures in patients over the age of 60 years is an effective method of treatment. This result disagreed with **Dundar et al., (2023)** study entitled" Clinical and Radiological Results of Patients Treated with Talon Distalfix Femoral Intramedullary Nail for Femoral Shaft Fractures, which revealed that the majority of the studied patients their mean age was 46.8 years.

The current study found that most of the studied patients were males. This result could be explained by the fact that males are more likely than females to have a femoral shaft fracture. This study finding disagreed with **Elbarbary et al., (2021)** study titled "Outcome of intramedullary nail for fixation of osteoporotic femoral shaft fractures in the elderly above 60." Who reported that the majority of the studied patients were females.

In the current study, it was found that the majority of the studied patients were highly educated, were workers, and lived in rural areas, which was in line with **Chitnis et al., (2021),** who reported that the largest number of them originated from rural areas and were workers.

Regarding length of hospital stay, it was found that the highest percentages of the studied patients stayed from 5 to less than 10 days, which was not in line with the study performed by **Finkemeier et al., (2022)** in Portugal

entitled "Proximal humerus fractures: epidemiology and trends in surgical management of hospital-admitted patients in Portugal," which mentioned that the average length of stay in hospital was 4.8 days.

The results of the present study mentioned that the majority of the studied patients have diabetes followed by coronary heart disease, which was not in line with the retrospective cohort study of United States trauma centers conducted by **Byrne et al., (2017)** titled" Timing of femoral shaft fracture fixation following major trauma" and explained that the majority of the studied patients have hypertension followed by diabetes.

The results of the present study illustrated that the majority of the studied patients didn't have a surgical history, which was in line with **Miao et al., (2021)** retrospective study, " The need for nutritional assessment and interventions based on the prognostic nutritional index for patients with femoral fractures, "who explained that most of the studied patients didn't have a surgical history.

Regarding cause of injury; the results of the present study illustrated that, most frequent cause of fracture was a fall down which was not in line with study performed by **Ghouri et al., (2023**). In their study titled Management of Traumatic Femur Fractures: A Focus on the Time to Intramedullary Nailing and Clinical Outcomes who reported that most frequent cause of fracture was motor vehicle crashes.

According to the present study finding there was a highly statistically significant difference regarding the occurrence of some complications in the two groups throughout the phases of follow-up duration post rehabilitation protocol as regards vascular injuries, swelling and wound-healing problems, infections, malunion, non-union, and soft tissue irritation at the entry point P value=0.001**. Deep vein thrombosis (p.value=0. 038*) and knee stiffness (p.value= 0.008**). This suggests that the nursing rehabilitation protocol can be an effective treatment for reducing incidence of complications in patients who underwent intramedullary nailing of femoral shaft fractures. This result was agreed with **Anusitviwat et al., (2021)** in a study entitled Complications after intramedullary nail fixation of pathological versus non-pathological femoral shaft fractures: a retrospective cohort study in 233 patients, who reported that there was a highly statistically significant difference regarding the complications (p- value < 0.001*).

The results of the present study illustrated that there was a highly statistically significant difference throughout the phases of follow-up duration in all items of lower extremity functional scoring scale (P-value 0.001**). This suggests that the nursing rehabilitation protocol had a positive effect on of lower extremity function in patients who underwent intramedullary nailing of femoral shaft fractures. This result was agreed with **Maurya et al., (2023)** in a study entitled " Radiological and Functional Outcomes and Associated Factors After Secondary Intramedullary Nailing Among Patients with Open Fractures of the Lower Limb " who reported that there was a highly statistically significant throughout the phases of follow up duration in all items of lower extremity functional scoring scale (P-value <0.0001).

In respect to the present study findings, there was a highly statistically significant difference in the occurrence of some complications in the two groups throughout the phases of the follow-up duration post-rehabilitation protocol as regards vascular injuries, swelling, and wound healing problems, infections, malunion, non-union, and soft tissue irritation at the entry point (P value = 0.001**). Deep vein thrombosis (p value = 0.038*) and knee stiffness (p value = 0.008**). This suggests that the nursing rehabilitation protocol can be an effective treatment for reducing the incidence of complications in patients who underwent intramedullary nailing of femoral shaft fractures. This result was agreed upon by **Anusitviwat et al., (2021)** in a study entitled Complications after intramedullary nail fixation of pathological versus non-pathological femoral shaft fractures: a retrospective cohort study in 233 patients, who reported that there was a highly statistically significant difference regarding the complications (p-value < 0.001*).

The results of the present study illustrated that there was a highly statistically significant difference throughout the phases of follow up duration in all items of the lower extremity functional scoring scale (P-value 0.001**). This suggests that the nursing rehabilitation protocol had a positive effect on lower extremity function in patients who underwent intramedullary nailing of femoral shaft fractures. This result was agreed upon by Maurya et al. (2023) in a study entitled "Radiological and Functional Outcomes and Associated Factors After Secondary Intramedullary Nailing Among Patients with Open Fractures of the Lower Limb," who reported that there was a highly statistically significant difference throughout the phases of follow-up duration in all items of the lower extremity functional scoring scale (P-value <0.0001).

According to the present study, there was a highly statistically significant difference regarding the total mean score of the lower extremity functional scale throughout the phases of follow up duration (P-value 0.005**). This suggests that the nursing rehabilitation protocol was very important and resulted in significant improvements in lower extremity function. This result was agreed upon by **Santhanam et al., (2022)** in a study entitled Factors Determining the Functional and Radiological Outcome after Secondary Nailing in Open Fractures of Lower Extremity: A Prospective Cohort Study, who reported that there was a highly statistically significant difference regarding the total mean score of the lower extremity functional scoring scale (p-value = 0.030).

The present study mentioned that there was a significant positive correlation between the total lower extremity functional scoring scale and the personal data of the two groups post-rehabilitation protocol, except residence, as follows: age groups, gender, educational level, and occupation post-rehabilitation protocol. This suggests that these personal factors may have an impact on lower extremity function after surgery and that rehabilitation protocol may be more or less effective depending on these factors. It's possible that residence would not have a significant impact on lower extremity function.

This was supported by **Dingemans et al. (2017),** who studied "Normative data for the lower extremity functional scale (LEFS)" and found that there was a statistically significant correlation between the total lower extremity functional scoring scale and the personal data of patients. High scores were observed for the LEFS throughout the whole population, although they did decrease with age. Men had a slightly higher score than women.

The results of the present study illustrated that there was a relationship between the lower extremity functional scoring scale and the occurrence of some complications in the two groups throughout the phases of the follow-up duration post-rehabilitation protocol as regards swelling and wound-healing problems, infections, malunion, non-union, and soft tissue irritation at the entry point. This result may be due to the fact that complications are an important factor that affects lower extremity function. That is supported by **Grün et al., (2023),** who studied functional outcomes and health-related quality of life after reconstruction of segmental bone loss in the femur and tibia using the induced membrane technique and found that patients with femoral nonunion reported significantly decreased lower extremity function.

In summary, the evidence suggests that nursing rehabilitation protocol can be effective in reducing the occurrence of complications and improving lower extremity function after intramedullary nailing for femoral shaft fractures. While some studies report conflicting results or limitations in their findings, the majority of evidence supports the effectiveness of nursing rehabilitation protocol in improving both outcomes. Generally, nursing rehabilitation protocol can be a valuable component of rehabilitation after intramedullary nailing for femoral shaft fractures, and healthcare providers should consider incorporating nursing rehabilitation protocol into their treatment plans for patients with femoral shaft fractures.

Conclusion:

Based on the findings of the current study, it can be concluded that the implementation of a nursing rehabilitation

protocol for patients who had undergone intramedullary nailing for femoral shaft fracture significantly reduced the occurrence of complications and improved lower extremity function in the study group compared to the control group.

Recommendations:

Rehabilitation protocol for femoral shaft fractures should be carried out on an individual basis from the beginning of the fracture to prevent complications and improve lower extremity function. Nursing rehabilitation protocol is recommended to be an integral part of preoperative nursing teaching for patients undergoing intramedullary nailing surgery, and a booklet should be available at the trauma unit and orthopedic outpatient clinic as a reference. The present study should be replicated on larger study populations for generalization of the results.

Acknowledgement:

We wish to thank all the patients, their relatives, and orthopedic staff from Assiut University Hospital's trauma unit and orthopedic outpatient clinics for their cooperation in carrying out this study.

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