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Original Research Article

Evaluating the efficacy of rehabilitation outcomes of the femoral neck system in treating femoral neck fractures: a two-year prospective study

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ABSTRACT

Background: Femoral neck fractures are prevalent among the elderly, and the femoral neck system (FNS), introduced in 2017, provides a minimally invasive treatment option with a dynamic bolt feature that enhances stability and facilitates early mobilization.
Methods: This study involved 30 patients with femoral neck fractures treated with FNS at Dr. D. Y. Patil Medical College and Hospital from January 2021 to February 2023. The patients, aged 45-85 years, adhered to a structured rehabilitation protocol. Clinical outcomes were assessed using the Harris hip score (HHS) over 2-year follow-up period.
Results: The cohort consisted of 30 patients (mean age: 65±10 years; 70% male). Fractures were classified as Pauwels I (30%), Pauwels II (40%), and Pauwels III (30%). At the final follow-up, 27 patients (90%) achieved union. The HHS improved significantly from a mean of 35±10 preoperatively to 85±15 postoperatively. Complications included one implant failure, one instance of limb shortening, and one case of avascular necrosis.
Conclusions: The FNS is a safe and effective treatment for femoral neck fractures, promoting early weight-bearing and joint mobilization, leading to improved functional outcomes and reduced complications.

Keywords: Femoral neck fracture, FNS, Rehabilitation, Two-year follow-up, Early mobilization, HHS

INTRODUCTION

Neck of femur fractures have become a prevalent injury in the third to fourth decade of life, particularly among the elderly.[1] The femoral neck system (FNS), launched in 2017, represents a significant development in orthopaedic surgery treating femoral neck fractures. Its minimalist design and novel dynamic bolt function set it apart from conventional fixing methods. The dynamic bolt allows for regulated collapse of up to 20 mm with no lateral protrusion for the first 15 mm, improving fracture stability and permitting early mobilisation, which is crucial for postoperative healing.[2]

Rehabilitation following FNS surgery focuses on restoring mobility, strength, and function. The early post-operative phase involves pain management and gentle mobilisation to prevent complications such as deep vein thrombosis and muscle atrophy.[1] Physical therapy plays a crucial role, starting with range-of-motion exercises and progressing to weight-bearing activities as tolerated.[3] Studies have shown that early mobilization significantly improves outcomes, reducing the risk of long-term disability and enhancing the patient's quality of life.[4]

In contrast to cannulated screw fixation, FNS fixation allows for early mobilisation of patients.[5] There are still very few studies on the rehab strategy for FNS patients. As a result, we want to investigate the rehab regimen and determine its efficacy in improving the HHSs in our patients.

METHODS

Rehabilitation protocol for FNS surgery

Inpatient phase

Day 1: Exercises: Quadriceps strengthening exercises, hip, knee, and ankle range of motion exercises. Equipment: Walking aids as needed.

Day 3: Exercises: Passive assisted exercises for hip abduction and adduction, continued knee and ankle mobilization exercises. Goal: Maintain joint flexibility and promote circulation.

Outpatient phase

Day 15: Activity: Progress to partial or full weight-bearing walks without aids based on pain tolerance. Exercises: Active assisted strengthening exercises for hip and knee. Goal: Enhance muscle strength and the support joint stability.

Day 21: Activity: Encourage full weight-bearing walks without aids. Exercises: Comprehensive exercise regimen for joint function and muscle strength restoration.

General guidelines

Early mobilization: Initiate early weight-bearing with walking aids post-surgery.

Exercise focus: Restore range of motion, strength, and joint function across hip, knee, and ankle joints.

Progressive approach: Gradually increase exercise intensity and weight-bearing capability.

Monitoring: Individualize based on patient progress and pain tolerance.

Equipment

Walking aids (crutches, walker) as needed initially. Resistance bands or therapy bands for strengthening exercises. Stability balls or balance boards for balance and proprioception exercises.

Study duration

This study was conducted from January 2021 to February 2023.

Study design

This study employed a prospective observational methodology to assess the clinical outcomes of the FNS and its associated rehabilitation protocol.

Study participants

Inclusion criteria

Patients aged 45 to 85 years with femoral neck fractures treated at Dr. D. Y. Patil Medical College and Hospital were included in study.

Exclusion criteria

Patients with pathological fractures or severe comorbidities affecting mobility were excluded.

Sample size

A total of 30 patients were enrolled over a two-year period.

Intervention

Surgical procedure: All patients underwent surgical fixation using the FNS.

Rehabilitation protocol: A standardized rehabilitation protocol was initiated post-operatively, focusing on early mobilization and progressive exercises aimed at restoring joint function and strength.

Follow-up

Post-operative care: Patients were discharged within two weeks post-surgery.

Follow-up assessments: Serial X-rays were performed at 6 weeks, 12 weeks, 6 months, and 1 year to assess fracture healing and implant stability.

Outcome measures

Primary outcome: Clinical outcomes were evaluated using the HHS, assessing pain, function, and range of motion.

Secondary outcomes: Complications, re-operation rates, and patient-reported outcomes were also recorded.

Statistical analysis

Descriptive statistics were used to summarise patient demographics and clinical characteristics. Changes in HHSs over time were analysed using repeated measures ANOVA.

Ethical considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants, and ethical approval was granted by the institutional review board of Dr. D. Y. Patil medical college and hospital.

RESULTS

The research included 30 individuals with femoral neck fractures aged 45 to 85 years (mean age 65), with the majority being male (70%).

Fracture distribution includes the Pauwels I (30%), Pauwels II (40%), and Pauwels III (30%) categories. Patients had comorbidities such as hypertension (40%), diabetes (23%), and osteoporosis (17%) (Table 1).

Table 1: Demographic data of patients and their fracture patterns.

Parameters	N (%)
N	30
Mean age (in years)	65 (Range 45-85)
Gender distribution	Male: 21 (70), female: 9 (30)
Fracture classification	
Pauwels I	9 (30)
Pauwels II	12 (40)
Pauwels III	9 (30)
Comorbidities	
Hypertension	12 (40)
Diabetes mellitus	7 (23)
Osteoporosis	5 (17)

Over a 24-month follow-up period (range 24-26 months), the research found a 90% union rate, with 27 of 30 patients attaining fracture union. HHS averaged 35 before surgery, but increased dramatically to an average of 85 after surgery. This is statistically significant $p<0.05$). Implant failure, limb shortening, and avascular necrosis occurred in 3.3% of cases, respectively.

These data emphasise favourable clinical outcomes and minimal complication rates linked with FNS (Table 2).

Table 2: Clinical outcomes and complications of our FNS study.

Variables	Value
Outcome measure	
Follow-up duration (Months)	24 (Range 24-26)
Union rate	27/30 (90%)
Mean preoperative HHS	35 (Range 10-60)
Mean postoperative HHS	85 (Range 60-100)
Complications, N (%)	
Implant failure	1 (3.3)
Limb shortening	1 (3.3)
Avascular necrosis	1 (3.3)

DISCUSSION

Our study involving 30 femoral neck fracture patients, predominantly male, found a high union rate of 90% with 27 out of 30 patients achieving fracture union. The study also found that complications were infrequent, with implant failure, limb shortening, and avascular necrosis occurring in 3.3% of cases.

The findings of this study show that the FNS is a realistic and effective treatment option for FNF. The study's findings correspond with previous research by Saad et al and Wu et al who also reported favourable findings for FNS in regards to shorter hospital stays, more effectively functional findings, and less complication rates as opposed to traditional methods like cannulated screws (CS) and dynamic hip screws (DHS).[6,7]

The considerable increase in the HHS from 35 preoperatively to 85 postoperatively demonstrates the FNS's efficacy in improving hip function and relieving discomfort. Early weight bearing and mobilisation are critical, since prolonged immobility might result in problems such deep vein thrombosis, pneumonia, and muscular atrophy.[8-10] The planned rehabilitation protocol was critical to the healing process, emphasising the need of a comprehensive strategy that included surgery and a well-defined rehabilitation programme.[7]

Complications and management

Despite the generally excellent results, the study found a 10% complication rate, which included implant failure, limb shortening, and avascular necrosis. These problems, albeit relatively minor, highlight the need for careful picking of patients and surgical accuracy. The sole occurrence of implant failure might be related to low bone quality or improper implant placement. Limb shortening and avascular necrosis are established hazards of femoral neck fractures and their surgical treatment.

The FNS is a viable treatment option for femoral neck fractures, but it has been linked to peri-implant subtrochanteric fractures, especially in patients with incomplete nondisplaced fractures. These fractures can require further surgical intervention, emphasising the need for careful surgical technique to prevent stress risers.[11] However, we didn't encounter such complications in our series. Despite these complications, FNS offers lower revision rates and improved functional outcomes.[12]

Limitations

The study admits its shortcomings, such as the single-center design and the lack of a control group treated using other approaches. These limitations restrict our capacity to make solid conclusions regarding the FNS's comparative performance. The sample size is also small. Future studies should overcome these limitations by performing randomised controlled trials in numerous centres.

CONCLUSION

The study suggests that the FNS is an efficient and secure treatment for femoral neck fractures, with good clinical and functional results. The FNS is more resistant to

deformation and less sensitive to implant location variations. Early weight bearing, joint mobilisation, and a faster return to regular activities are all significant advantages. Future research should include randomised controlled trials and long-term studies to examine FNS implant durability and associated consequences.

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