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Comparing the Efficiency of the Femoral Neck System and the Cannulated Compression Screw in Treating Femoral Neck Fractures in Patients Who Are Young and Middle-aged Indian Population

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Abstract

Background: There are no long-term studies regarding the clinical effectiveness of a novel fixation technique (femoral neck system [FNS]) for femoral neck fractures. The primary aim of this study was to compare the effectiveness of two internal fixation techniques (FNS and cannulated compression screw [CCS] for treating femoral neck fractures in individuals between the ages of 20 and 40 years.

Materials and Methods: Data of patients who underwent internal fixation surgery for femoral neck fractures in our hospital between January 2018 and January 2020 with CCS and between January 2020 and January 2022 with FNS were retrospectively evaluated. The groups of CCS and FNS were separated based on the various internal fixation techniques. Demographics about all patients, including sex, age, body mass index, and fracture type were recorded. Pre-operative and 1- year post-operative follow- up of patients was to assess femoral neck shortenings and the Harris Hip score was used to evaluate joint function. Post-operative complications such as femoral head necrosis, non-union, and femoral neck shortening were noted.

Results: 30 patients each of CCS and FNS system fixation were enrolled in the study. The male-to-female ratio was 21:9 and 18:12 for CCS and FNS, respectively. The average age of both groups was around 30 years. Compared to patients treated with CC screws, patients who had FNS treatment required less time to recuperate and resume normal activities. The HSS score improvement at 2 weeks and 12 weeks was significantly better in the FNS system than CCS fixation. There was improvement in flexion, abduction, and external rotation range of motion in FNS compared to CCS. There was no statistically significant difference between the two groups in the incidence of femoral head necrosis or fracture non-union following surgery.

Conclusion: Patients treated with FNS for femoral neck fractures in the age range of 20-40 years can achieve better hip scores than CCS fixation and also have improved range of motion in flexion, abduction, and external rotation.

Keywords: Femoral neck system, cannulated cancellous screw, femoral neck fractures, harris hip score

Introduction

Intracapsular femoral neck fractures are frequently observed in the senior population after minor trauma [1]. Femoral neck fractures in people under the age of 50 are rare, and they frequently occur as a result of high-energy trauma. Only 2 –3% of all femoral neck fractures are caused by them [2]. Understanding the characteristics between elderly and young adult patients is crucial for the evaluation and treatment

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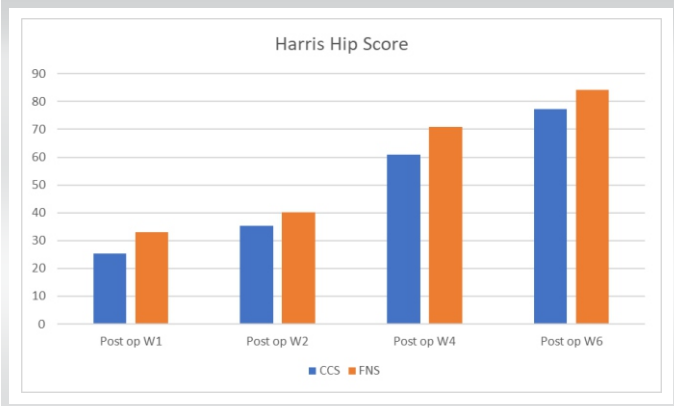

Figure 1: Improvement of Harris Hip score in cannulated compression screw and femoral neck system treatment modes recorded at post-operative period of 1, 2, 4, and 6 weeks.

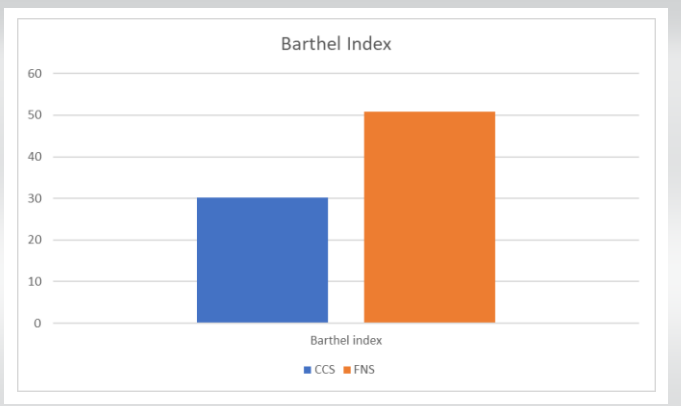

Figure 2: Improvement of Barthel index in cannulated compression screw and femoral neck system treatment modes recorded preoperatively and immediately post-operative period of 2 weeks.

of femoral neck fractures in young adults. There are noticeable differences in the osseous and vascular structure, injury manner, associated injuries, fracture pattern, and therapeutic goals [1].

The incidence of femoral head osteonecrosis and non-union is greater in young individuals with femoral neck fractures [3]. After a femoral neck fracture, young individuals have an osteonecrosis rate ranging from 12% to 86% [3]. This terrible consequence might cause the femoral head to collapse, leading to osteoarthritis. Arthroplasty operations are not optimal given the young age due to increased levels of activity, and reoperation rates and salvage procedures such osteotomies have significant failure rates [4]. Even though attaining an anatomic reduction and secure internal fixation are essential, other treatment factors such as the amount of time before surgery, the function of the capsulotomy, and the fixation techniques are still up for debate.

Many patients who have had a hip fracture are unable to regain their degree of independence before the fracture [5]. Risk factors include advanced age, the existence of comorbid conditions, a lack of autonomy before the fracture, and prolonged bed rest (regular use of an air pressure mattress, an increase in the number of days spent confused, an inability to recover, a long-term urine catheter, and short-term care support) [6]. Inactivity for an extended period of time can impair functionality and increase the risk of hospital-related issues such as falls and pressure sores.

Early activity, on the other hand, seems to lessen comorbidities associated with bed rest and functional decline. Following the fundamental principles of an early mobiliz ation protocol is associated with better patient outcomes, including a shorter hospital stay and maintenance or improvement of functional status from admission to discharge, according to recent evidence [7]. Receiving post-operative rehabilitation is associated with improved outcomes and a higher chance of regaining the prior functional level. Various post-operative rehabilitation techniques have been the subject of numerous researches. Quick and thorough care after hip surgery has been shown to result in early post-operative improvement, and early mobilization enhances early recovery [7].

FNS is a new implant for femoral neck fractures introduced by AO, which has been shown to have better rotational stability and less varus collapse [7,8].

Fixation method used for femoral neck

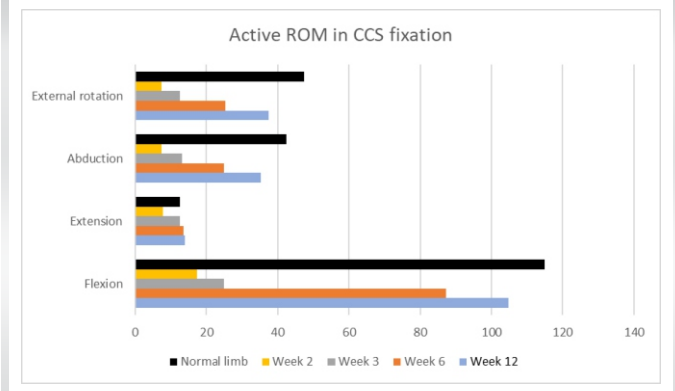

Figure 3: Improvement of affected limb active range of motion in terms of various types of motion in cannulated compression screw treatment mode.

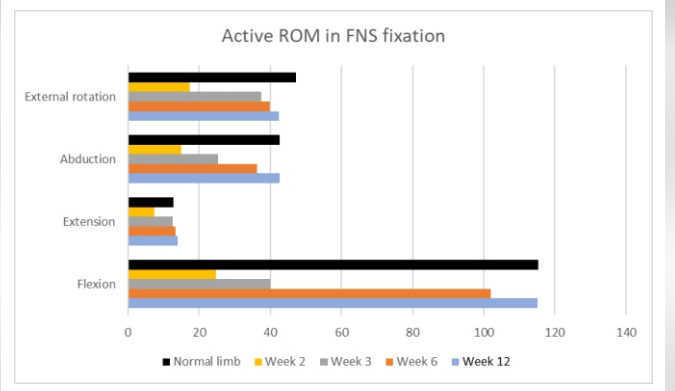

Figure 4: Improvement of affected limb active range of motion in terms of various types of motion in femoral neck system treatment mode.

Table 1- : Average values of HSS and range of motion (ROM) for both passive and active modes in patients managed with CCS fixation.

CCS	Pre-operative	Post - operative 1 week	Post -operative 2 weeks	Post - operative 3 weeks	Post - operative 6 weeks	Post - operative 12 weeks
HHS			25.2	35.2	60.8	77.2
Barthel index		30.17				
Flexion ROM			17.4	24.9	87.3	104.8
Passive flex ROM	22.5		22.5	27.5	97.4	107.4
ROM extension			7.4	12.6	13.5	13.9
Passive ROM extension			7.9	12.5	14	14
ROM Abduction			7.4	13.2	24.9	35.2
Passive ROM abduction			7.5	17.5	27.4	35.1
ROM external rotation			7.4	12.5	25.3	37.5
Passive ROM external rotation			7.5	17.5	32.6	40

ROM: Range of motion, CCS: Cannulated compression screw, HSS: Harris Hip score

fractures (FNFs) guides rehabilitation protocol. Depending on the type of fixation implant used, mobilization protocol changes. In comparison to their non-fractured limb, patients typically lose more than 50% of their fractured limb's muscular strength during the first few weeks following surgery [8]. Mobilization after cannulated compression screws (CCS) is done when signs of radiological union present in X-rays around 6–8 weeks [9]. In FNS, mobiliz ation can be done early starting at 1 week to 10 post-operative days depending on patient general condition [10]. The objective of this study is to assess the effectiveness of early rehabilitation regimen and return to function in post-operative cases of FNF when treated with CCS and FNS.

Materials and Methods

In a tertiary care hospital, patients who underwent internal fixation surgery for femoral neck fractures by a single skilled surgeon between January 2018 and January 2020 with cannulated compression screws (CCS) and between January 2020 and January 2022 with a femoral neck system (FNS) were retrospectively evaluated. A 4-year study was conducted. Patients included are skeletally mature between the ages of 20 –40 years and had full range of motion at affected hip joint before fracture. Patients who have a history of osteopenia and hip arthritis have been excluded from the study.

During rehabilitation of patients post operatively, CCS patients were started on closed chain exercises, namely skateboard exercises and knee bending exercises till pain tolerance on postoperative day 2. CCS patients were started on nil weight bear walking and mobilization after 6 post-operative weeks. Various parameters such as Barthel index (BI), Harris Hip score, and ROM in normal and affected limb were recorded at 1, 2, 4, 6, and 12 weeks, postoperatively.

Statistical methods

Parameters between CCS and FNS were tested by unpaired T-test, while range of motions at various periods after surgery for the same treatment method was tested using paired T-test.

Results

30 patients of each CCS and FNS were included in the study. All of the patients with transcervical neck of femur fracture were included. Male: female ratio of 21:9 and 18:12 for CCS and FNS, respectively. In the young age group of 20–40 years old, all patients had high velocity trauma such as road traffic accidents and falls from height. The average age of CCS and FNS groups was similar (30 years).

Table 2- : Average values of HSS and Range of motion (ROM) for both passive and active modes in patients managed with FNS fixation.

FNS	Pre-operative	Post - operative 1 week	Post - operative 2 weeks	Post - operative 3 weeks	Post - operative 6 weeks	Post - operative 12 weeks
HHS			33	40.2	70.8	84.3
Barthel index		50.83				
Flexion ROM			24.8	40	101.9	115.2
Passive flex ROM	29.9		29.9	54.9	115.5	117.3
ROM extension			7.5	12.5	13.4	14.1
Passive ROM extension			7.6	13.3	13.5	13.5
ROM abduction			14.9	25.3	36.2	42.6
Passive ROM abduction			15	32.4	42.6	42.6
ROM external rotation			17.3	37.5	39.9	42.5
Passive ROM external rotation			22.4	37.5	42.5	42.6

ROM: Range of motion, FNS: Femoral neck system, HSS: Harris Hip score

Harris Hip score (HSS)

As the patient was preoperatively in a lot of pain, no HHS was recorded preoperatively. The post-operative HSS of CCS and FNS was recorded at regular intervals as depicted in the Fig. 1, Tables 1 and 2.

HSS improved statistically significantly between post-operative 2 weeks and 12 weeks in CCS and FNS systems ($P < 0.001$). Furthermore, there were statistically significant better HSS scores in FNS compared to CCS fixation both at 2 weeks and 12 weeks postoperatively ($P < 0.001$).

BI

The BI, developed in 1955, evaluates everyday activities such as feeding, bathing, grooming, and toilet usage. A score of 100 shows high autonomy, while a score of 0 implies absolute reliance [11]. There were statistically better scores of BI in the FNS group compared to the CCS group of patients (Fig. 2, Tables 1 and 2).

CCS fixation group (Table 3)

All ROM had statistically significant improvement when compared post-operative 2 weeks and 12 weeks except as seen in Table 3.

The mean improvement of active ROM of flexion, extension, abduction, and external rotation seen in the CCS group was 83.4%, 46.7%, 79%, and 80.2%, respectively. The passive ROM change was of around similar percentages (Fig.3).

FNS fixation group (Table 2)

All ROM had statistically significant improvement when compared post-operative 2 weeks and 12 weeks as seen in Table 3. The mean improvement of active ROM of flexion, extension, abduction, and external rotation seen in the CCS group was 78.4% , 46.7%, 65.1%, and 59.2%, respectively. The passive ROM change was of around similar percentages except for passive external rotation improvement was just 47.5 % (Fig. 4).

Comparison of FNS and CCS fixation

There was statistically significant improvement in Barthel index, HSS scores, and ROM of flexion, abduction, and external rotation. Extension movements were not significantly better. ROM is shown in Table 3.

Discussion

In a 6- month follow-up retrospective study by Zhang et al., the FNS group scored higher on the Harris scale and had a lower implant removal rate compared to the CCS group. There were no major differences in treatment-related problems, but the FNS group had fewer issues [12]. Yang et al. showed in their study of 59 patients that the use of FNS to treat Pauwels type III femoral neck fracture is straightforward and effective in reducing femoral neck shortening and changing the caput-collum-diaphysis angle. Furthermore, FNS promotes the rehabilitation of hip joint function and should be regarded as a novel option for the treatment of juvenile femoral neck

Table 3- : Statistical analysis of various results comparing different times of CCS and FNS and also comparing FNS versus CCS fixation.

S. No.	Category 1	Category 2	Test of Significance	P value
	Barthel index FNS	Barthel index CCS	Unpaired T-test	<0.00001
1	FNS HSS 2 weeks post-operative	CCS HSS 2 weeks post-operative	Unpaired T-test	<0.00001
2	FNS HSS 6 weeks post-operative	CCS HSS 6 weeks post-operative	Unpaired T-test	<0.00001
3	CCS HSS 1 weeks post-operative	CCS HSS 6 weeks post-operative	Paired T-test	<0.00001
4	FNS HSS 1 weeks post-operative	FNS HSS 6 weeks post-operative	Paired T-test	<0.00001
6	FNS active flexion 2 weeks post-operative	CCS active flexion 2 weeks post-operative	Unpaired T-test	<0.00001
7	FNS active flexion 12 weeks post-operative	CCS active flexion 12 weeks post-operative	Unpaired T-test	<0.00001
8	FNS active flexion 2 weeks post-operative	FNS active flexion 12 weeks post-operative	paired T-test	<0.00001
9	CCS active flexion 2 weeks post-operative	CCS active flexion 12 weeks post-operative	paired T-test	<0.00001
10	FNS active extension 2 weeks post-operative	CCS Active extension 2 weeks post-operative	Unpaired T-test	0.440124
11	FNS active extension 12 weeks post-operative	CCS active extension 12 weeks post- operative	Unpaired T-test	0.262272
12	FNS active extension 2 weeks post-operative	FNS active extension 12 weeks post-operative	Paired T-test	<0.00001
13	CCS active extension 2 weeks post-operative	CCS active extension 12 weeks post-operative	Paired T-test	<0.00001
14	FNS active abduction 2 weeks post-operative	CCS active abduction 2 weeks post-operative	Unpaired T-test	<0.00001
15	FNS active abduction 12 weeks post-operative	CCS active abduction 12 weeks post-operative	Unpaired T-test	<0.00001
16	FNS active abduction 2 weeks post-operative	FNS active abduction 12 weeks post-operative	Paired T-test	<0.00001
17	CCS active abduction 2 weeks post-operative	CCS active abduction 12 weeks post-operative	Paired T-test	<0.00001
18	FNS active external rotation 2 weeks post-operative	CCS active external rotation 2 weeks post-operative	Unpaired T-test	<0.00001
19	FNS active external rotation 12 weeks post-operative	CCS active external rotation 12 weeks post-operative	Unpaired T-test	<0.00001
20	FNS active external rotation 2 weeks post-operative	FNS active external rotation 12 weeks post-operative	Paired T-test	<0.00001
21	CCS active external rotation 2 weeks post-operative	CCS active external rotation 12 weeks post-operative	Paired T-test	<0.00001

FNS: Femoral neck system, HSS: Harris Hip score, CCS: Cannulated compression screw

fracture patients [13]. Yan et al. published a similar study with comparison of CCS and FNS fixation in middle- aged population of 82 patients, in which they showed that HSS was better in the FNS group and also that FNS had less complications than CCS group [14].

In our study, we found that the range of motion improved in FNS group significantly compared to CCS group. Furthermore, the HSS and BI have improved in FNS group.

The use of FNS in opposition to CCS in the Indian population is discussed for the first time in the literature. The improvement in range of motion, both passive and active, as well as functional scores such as the HSS and BI, are explained in our paper.

Our study has a few drawbacks. The information is gathered retrospectively. The sample size is small and the follow-up is brief, which limits the ability to identify instances that progressed to avascular necrosis and hip and ultimately required hip replacement.

We suggest that longer follow-up studies with randomized controlled trials can help to ascertain the efficacy of FNS over CCS fixation in femoral neck fractures.

Conclusion

FNS can hasten the healing of femoral neck fractures among young and of middle age individuals, enabling them to begin functional activity sooner and lowering the risk of associated problems. Additionally, compared to CCS fixation, FNS improves hip range of motion and functional assessments better with time.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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