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Retro - Prospective Comparative Study of Internal Fixation of Intra Capsular Neck of Femur Fracture by Dynamic Hip Screw Plate and Cannulated Cancellous Screw

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Abstract: ***Background: Dynamic hip screw (DHS) with or without derotation and cannulated cancellous screw (CCS) fixation are two common management strategies for intracapsular neck femur fractures. Methods: A total of 64 patients were included, of which 34 were treated with DHS and 31 with CCS. The study assessed various parameters such as operative time, intraoperative blood loss, mobilization protocols, fracture union time, loss of reduction, incidence of avascular necrosis and its complications, and Harris hip score. Results: The mean age of patients in the CCS group was significantly lower than that of the DHS plating group, without significant difference in gender distribution, side of fracture, co - morbidities, operative time, blood loss, radiological union time, Harris Hip Score, and complications. The majority of patients in both groups achieved radiological union beyond 22nd weeks till 30th weeks, and non - union was reported in 3% of patients in DHS group. Conclusion: The study suggests that both CCS fixation and DHS plating are equally effective for treatment of intracapsular neck of femur fractures, and the choice of surgical procedure should be based on patient - specific factors.***

Keywords: hip fracture, femur fracture, dynamic hip screw, cannulated cancellous screw, surgical outcomes

1. Introduction

Intracapsular neck femur fractures are seen as fragility fractures from trivial falls in older people. These fractures are associated with significant morbidity and mortality, with up to 30% of patients experiencing complications such as pulmonary embolism, pneumonia, or pressure ulcers. Therefore, prompt and appropriate management of these fractures is critical to ensure optimal outcomes. [1, 2]

Fracture neck femur are an intracapsular fractures occurring through the neck of femur, which is a junction between head and the trochanter and this being a junctional area causes increased stress over neck of femur. The medial circumflex femoral artery, which is located on the neck of the femur, provides the majority of the retrograde blood flow to the neck. Therefore, the blood supply is disrupted by displaced fractures of the intra capsular type.

Fixation and arthroplasty surgery are both available options and the choice of modality is determined depending on the age, type of fracture, mode of injury, bone quality, and pre - existing co - morbidity, functional demand of the patient [3]. Young patients are not recommended for arthroplasty surgery due to differences in activity and young age [4] Dynamic hip screw (DHS) with or without derotation and cannulated cancellous screw (CCS) fixation are among the management strategies to treat these fractures. [5]

CCS fixation involves the placement of 3 or more screws across the fracture site to achieve stable fixation. Cannulated cancellous screws or Dynamic Hip screws with/without derotation screws are typically used to open reduce and internally fix transcervical and basicervical neck of femur fractures. [6] The goal is to achieve union and prevent avascular necrosis while maintaining the bone stock. [2]

Various clinical, cadaveric, and biomechanical studies are conducted, concluding both DHS and cannulated cancellous screws are capable of compression, but the fracture site may affect how well they hold a reduction. Compression is challenging to achieve if cannulated screws are not positioned parallel to one another. [7, 8, 9]

The aim of this study is to compare the functional outcomes of patients who underwent DHS fixation with or without derotation and CCS fixation for intracapsular neck of femur fractures.

2. Materials & Methods

Study Design: -
The present study is a comparative analytical study that utilizes both retrospective and prospective designs to compare the outcomes of dynamic hip screw (DHS) and cannulated cancellous screw (CCS) fixation for the management of intracapsular neck of femur fractures.

Setting:
The study was carried out over a period of 24 months in the Department of Orthopaedics, Bharati Hospital and Research Centre, Dhankawadi, Pune.

The prospective component of the study was conducted from 1st October 2020 to 31st September 2022, while the

retrospective component covered the period from 1st October 2015 to 1st September 2020.

Inclusion criteria: -
All admitted patients above 15 years of age, diagnosed with all neck of femur fractures, with no active infection and with patients willing to participate in the study.

Exclusion criteria: -
Patients with active hip infection, pre - existing arthritis of the affected hip joint, patients not willing to participate in the study, and patients with pathological fractures were excluded from study.

Sample size and participants: -
A total sample size of 65 was included in the study, of which 34 patients were treated with DHS and 31 patients were treated with CCS.

The study methodology involved a detailed history of the patients with intracapsular neck of femur fractures was obtained and entered into a specially designed proforma.

Sampling Technique: -
The study was a non - randomized study, and the decision of implant was made by the operating surgeon depending on the fracture anatomy. All necessary preoperative work - up, including hematological and radiological examinations, was done for the patients, and after well - written informed consent was taken from all the patients. Local ethical committee approval was obtained before commencing the study.

The study was determined by the clinical, radiological, and functional outcome after internal fixation with DHS compared to CCS. Follow - up intervals were at 6 weeks, 3 months, 6 months, and 9 months after surgery.

Parameters to be studied: -
The parameters studied included operative time, intraoperative blood loss, mobilization protocols (non - weight - bearing vs. partial weight - bearing), age and sex - related differences, loss of reduction, fracture union time comparison/delayed/non - union, incidence of avascular necrosis and its complications, incidence of osteoporosis and its complications, and Harris hip score [FIGURE 7 (APPENDICES)].

The data collected and statistical analysis was done using statistical package for social sciences (SPSS, IBM version 26.0). The qualitative parameters were compared between groups using Chi - square test. The difference in the means was compared by means of student ‘t’ test. The level of significance was fixed at 5%, and p <0.05 was considered statistically significant.

The above study has been approved by Bharati Vidyapeeth (Deemed to be university) Medial College, Pune, Institutional ethics committee (DCGI Reg No. ECR 518/Inst/MH/2014/RR - 17), Ethics code - BVDUMC/IEC/125 on 7th December 2020.

3. Results

A total of 64 patients with fracture of intracapsular neck of femur were included in the study, of which 31 were treated with CCS fixation and 33 were treated with DHS plating. The mean age of the patients in CCS fixation group was 46.74 ± 17.09 years and in DHS plating it was 57.82 ± 14.26 years. The difference in the means of ages between groups was significant (p=0.0006). There were 14 and 22 males in CCS fixation and DHS plating group, respectively, while there were 17 and 11 females, without any statistical (p=0.0831) difference in distribution. Out of the total 64 patients included in the study, 33 (51.6%) had a fracture in the left side of the neck of femur while 31 (48.4%) had the fracture on the right side, and 24 (37.5%) had one or more co - morbidities while 40 (62.5%) had no co - morbidity.

Under the CCS fixation category, 22 patients were treated with closed reduction and internal fixation (CRIF) using CCS, while 9 patients were treated with open reduction and internal fixation (ORIF) using CCS. Under the DHS plating category, 12 patients were treated with CRIF using DHS plating with or without a de - rotation screw, and 21 patients were treated with ORIF using DHS plating with or without a de - rotation screw. The remaining 21 patients who underwent ORIF with DHS plating were not specified. (Table 1)

Table 1: Operative Procedure underwent by both Cannulated cancellous screw group and Dynamic hip screw plating group

	Operation	Frequency	Total
CC screw fixation	CRIF with CC screw fixation	22	31
	ORIF with CC screw fixation	9	
DHS plating	CRIF with DHS plating with or without de - rotation screw	12	33
	ORIF with DHS plating with or without de - rotation screw	21	
	Total	64	64

In the CCS fixation group, 4 patients (66.7%) had surgery time less than 70 minutes, 3 patients (75%) had surgery time between 70 - 79 minutes, 4 patients (66.7%) had surgery time between 80 - 89 minutes, and 20 patients (41.7%) had surgery time 90 minutes or more. In the DHS plating group, 2 patients (33.3%) had surgery time less than 70 minutes, 1 patient (25%) had surgery time between 70 - 79 minutes, 2 patients (33.3%) had surgery time between 80 - 89 minutes, and 28 patients (58.3%) had surgery time 90 minutes or more. The p - value for the comparison between the two groups is 0.2980, indicating that there is no statistically significant difference between the operative times of the two groups. (Table 2)

Table 2: Comparison of operative time (in minutes) between Cannulated cancellous screw group and Dynamic hip screw plating group

	CC screw		DHS Plating		p value
	N	%	N	%	
<70	4	66.7	2	33.3	0.298
70 - 79	3	75	1	25	
80 - 89	4	66.7	2	33.3	
>=90	20	41.7	28	58.3	
Total	31	48.4	33	51.6	

According to the table *3*, 20 patients (58.82%) in the CCS group had blood loss less than 100 ml, while 14 patients

(41.18%) in the DHS plating group had blood loss less than 100 ml. In the 100 - 150 ml category, 6 patients (40%) in the CCS group and 9 patients (60%) in the DHS plating group had blood loss. In the 151 - 200 ml category, only 1 patient (25%) in the CCS group and 3 patients (75%) in the DHS plating group had blood loss. Similarly, in the 200 - 300 ml category, 3 patients (33.33%) in the CCS group and 6 patients (66.67%) in the DHS plating group had blood loss. In the >300 ml category, 1 patient (50%) in each group had blood loss.

The total number of patients in the CCS group was 31, with 48.44% blood loss, while the DHS plating group had 33 patients, with 51.56% blood loss. The p - value for the comparison of blood loss between the two groups was 0.4629, which indicates that there was no significant difference in blood loss between the two groups. (Table 3)

Table 3: Comparison of amount of blood loss (ml) between Cannulated cancellous screw group and Dynamic hip screw plating group

Amount of blood loss (ml)	CC screw		DHS Plating		p value
	N	%	N	%	
<100	20	58.82	14	41.18	0.4629
100 - 150	6	40	9	60	
151 - 200	1	25	3	75	
200 - 300	3	33.33	6	66.67	
>300	1	50	1	50	
Total	31	48.44	33	51.56	

The period in week for radiological union was noted and compared between the groups based on 2 methods viz. CCS fixation and DHS plating fixation. The radiological union in majority of the cases was observed beyond 22nd week till 30th weeks in both the groups. Non - union was reported in 1 and 2 patients in CCS and DHS plating group, respectively. The distribution of patients as per the period in weeks for radiological union did not differ significantly (p=0.5280) between the groups. (Table 4)

Table 4: Table describing Radiological union (at weeks) between Cannulated cancellous screw group and Dynamic hip screw plating group

Radiological union at weeks	CC screw		DHS Plating		p value
	N	%	N	%	
18	4	0	1	100	0.528
20	4	100	4	0	
22	7	46.7	8	53.3	
24	8	44.4	10	55.6	
26	1	38.5	4	61.5	
28	3	66.7	3	33.3	
30	3	75	1	25	
Total	31	48.4	33	51.6	

The table 5 shows the frequency and percentage of patients in each group who achieved different levels of Harris Hip Score, namely Excellent (90 to 100), Good (80 to 89), Fair (70 to 79), and Poor (<70). The p - value for the comparison is also given, which shows the statistical significance of the differences between the two groups. In this case, the p - value is 0.53, which is not statistically significant, indicating that there is no significant difference in the Harris Hip Score between the two surgical procedures.

Table 5: Table describing comparison of Harris hip score between Cannulated cancellous screw group and Dynamic hip screw plating group

Harris hip score	CC screw		DHS Plating		p value
	N	%	N	%	
Excellent (90 to 100)	8	47.1	9	52.9	0.53
Good (80 to 89)	14	50	14	50	
Fair (70 to 79)	8	57.1	6	42.9	
Poor (<70)	1	20	4	80	
Total	31	48.4	33	51.6	

In CCS fixation group the complications were reported among 4 patients, of which 1 patient each had avascular necrosis and infection, and 2 patients had implant failure. In DHS plating group also complications were reported in 4 patients, 1 patient each had implant failure, infection, non - union and remaining 1 patient had infection with implant failure. The distribution of patients as per complications did not differ significantly (p=0.4790) between groups. (Table 6)

Table 6: Table showing frequency of complications between Cannulated cancellous screw group and Dynamic hip screw plating group

Complications	CC screw		DHS Plating		p value
	N	%	N	%	
Avascular necrosis	1	3.23	0	0	0.479
Implant Failure	2	6.45	1	3.03	
Infection	1	3.23	1	3.03	
Infection + Implant Failure	0	0	1	3.03	
Non - Union	0	0	1	3.03	
None	27	87.1	29	87.88	
Total	31	100	33	100	

The association between age of the patients in years and complication was assessed based on presence or absence of complication. We found no significant (p=0.745) difference between ages of patients based on presence or absence of complications.

The mean values of blood loss, operative time, Harris hip score and radiological union time in weeks were calculated and compared between the groups. We found no significant difference in any of these parameters between the two groups. The mean ± SD values with respective p values are shown in table 7.

Table 7: Comparison of blood loss, duration of surgery, Harris hip score and radiological union

	DHS plating		CC screw		p value
	Mean	SD	Mean	SD	
Blood loss (ml)	141.06	100.3	101.94	111.09	0.1407
Duration of surgery (minutes)	126.82	38.77	109.52	37.69	0.0734
Harris hip score	81.33	13.25	83.3	9.37	0.4953
Radiological union at weeks	24.39	2.5	25.07	2.72	0.2976

Complications: -

In terms of complications, the study found that the CCS group had 4 patients with complications, including avascular necrosis, infection, and implant failure. In comparison, the DHS plating group had 4 patients with complications, including implant failure, infection, non - union, and infection with implant failure. The distribution of complications did not differ significantly between the two groups, suggesting that

both surgical procedures have comparable outcomes in the management of femoral neck fractures.

Some cases with complications:

One of the cases which had reported with complication was from CCS group, patient was operated for neck of femur fracture for which closed reduction internal fixation with CCS was done in 2017, and implant removal was done in 2019 with no reported complications. But the patient presented after 3 years in 2022 with complaints of left hip pain and inability to sit cross legged, on X - ray and MRI it was confirmed with avascular changes of left hip, with sclerosis of the femoral head and maintained sphericity of femoral head on X - ray, patient was then operated for core hip decompression with platelet rich plasma injection with a trial to conserve the femoral head. [FIGURE 1 (A, B), 2 (A, B), 3 (A, B), 4 (A, B)]

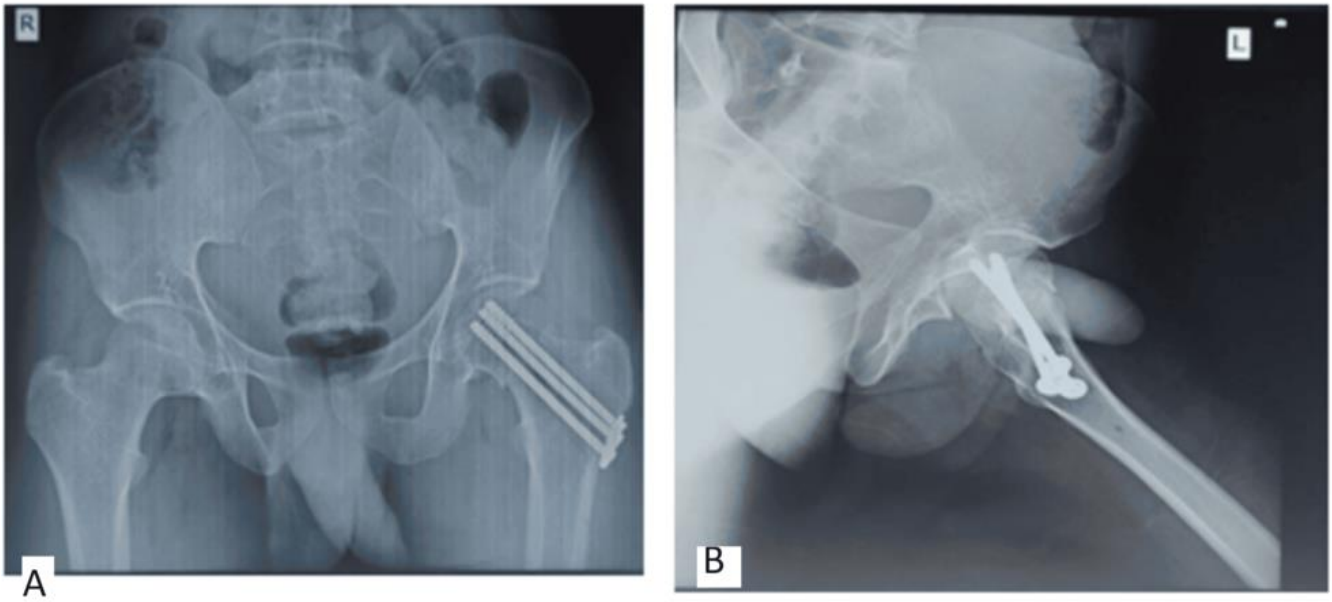

Figure 1: Immediate post operative X - ray images on 25/09/2017

Shows cannulated cancellous screw fixation done in both (A) Anteroposterior and (B) Lateral view

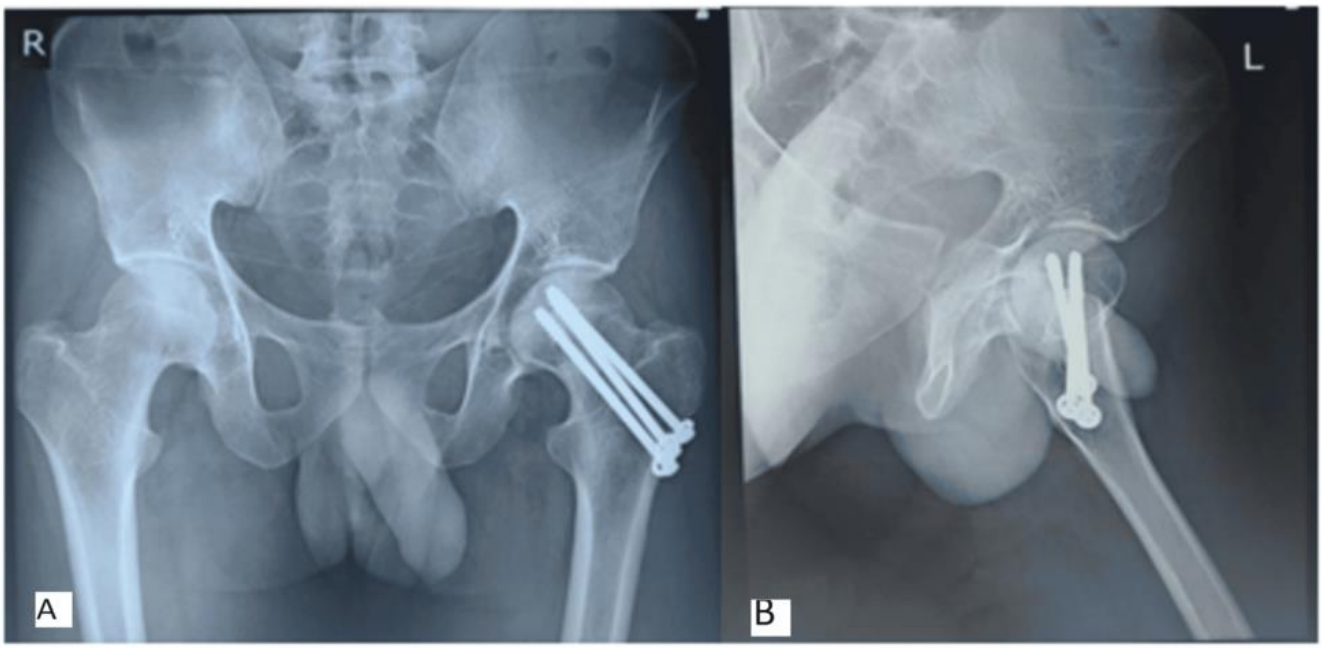

Figure 2: Follow up post operative X - ray after 2 years showing united neck femur fracture with implant in situ (A) Anteroposterior view, (B) Lateral view

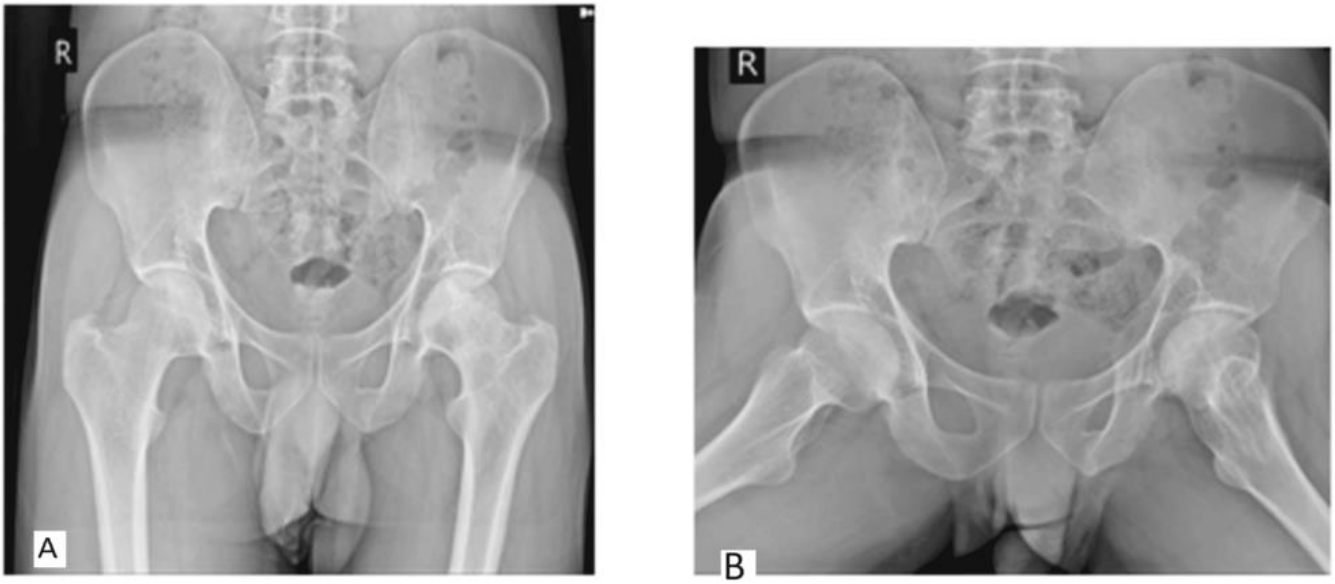

Figure 3: X - ray showing Avascular necrosis of femoral head changes over left side hip
(A) Anteroposterior view, (B) Frog Leg - Lateral view

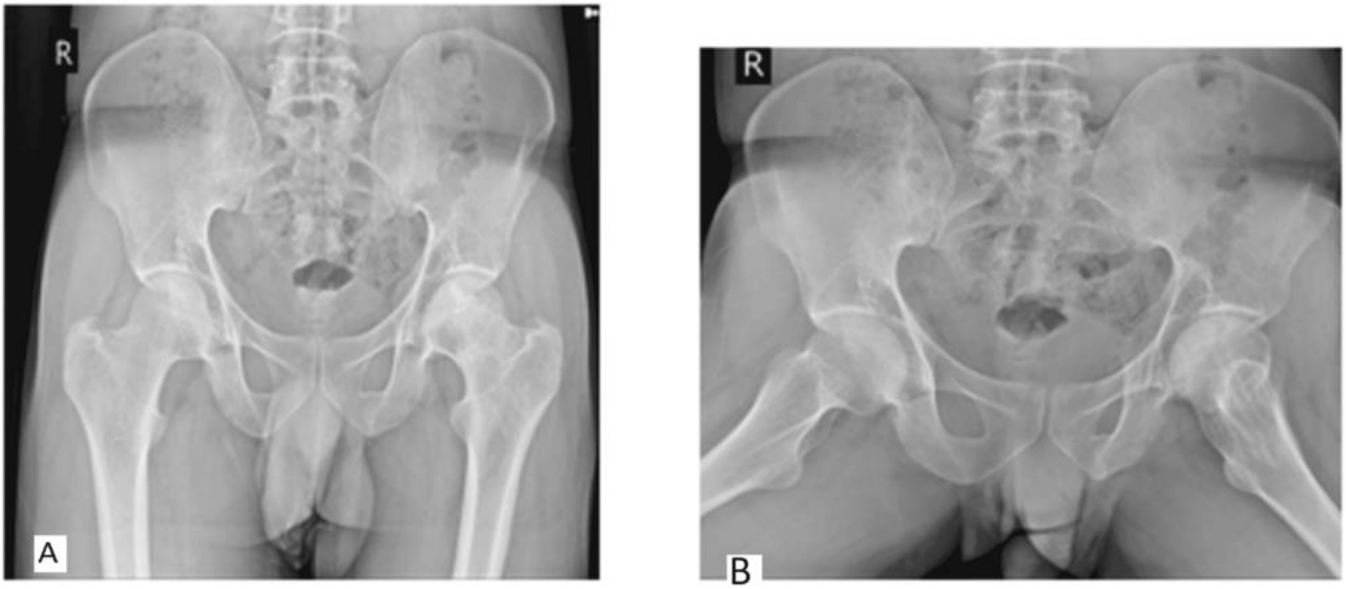

Figure 4: X - ray showing Avascular necrosis changes over left side hip
(A) Anteroposterior view, (B) Frog Leg - Lateral view

One of the patient from DHS plating group was reported to have non union, patient was operated on 2/10/2020 for neck of femur fracture for which DHS plating was done. Patient had came with complaints of pain over the affected hip and difficulty walking since 1 year, following the surgery

On X - ray image non united femoral neck with implant failure was seen. [FIGURE *5* (A, B)]

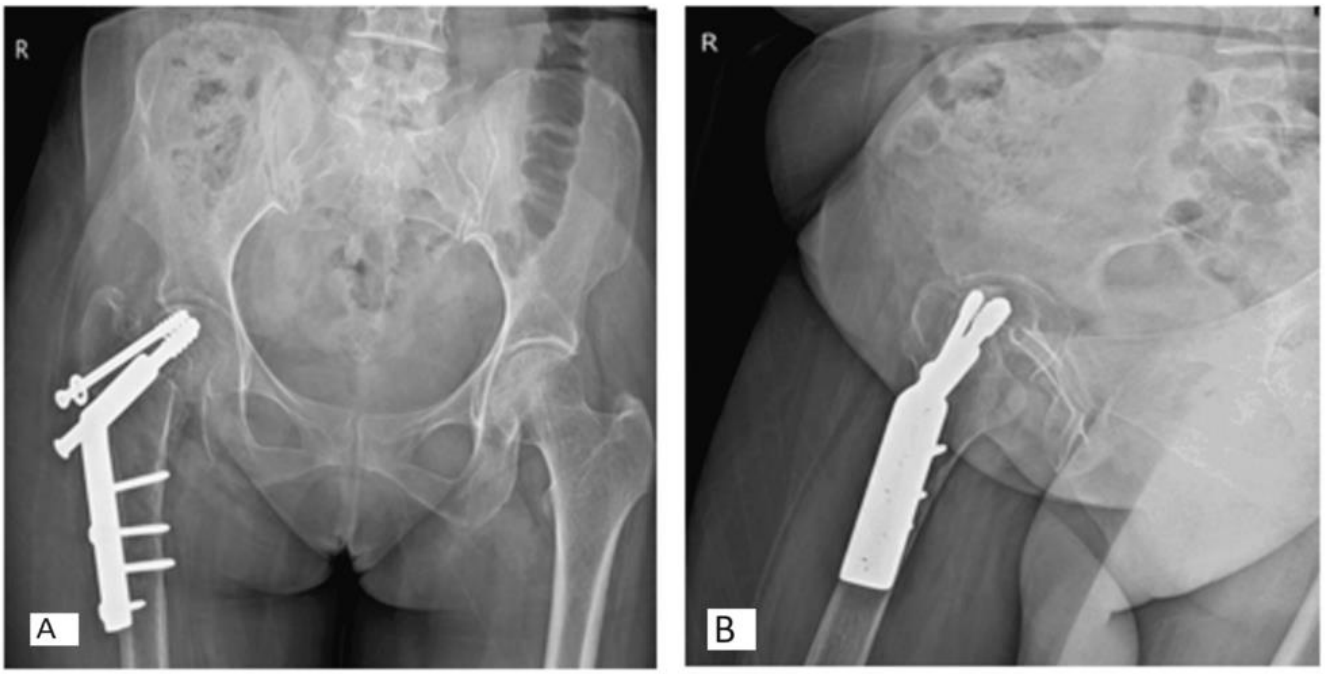

Figure 5: X - ray image non united femoral neck with implant failure was seen.
(A) Anteroposterior view, (B) Lateral view

Patient was taken for operative procedure of bipolar hemi - arthroplasty was to be done, intra operatively during broaching, fracture occurred of proximal femoral shaft. Patient was then given Thomas splint and was posted later for long stem bipolar hemi - arthroplasty. [FIGURE *6* (A, B)]

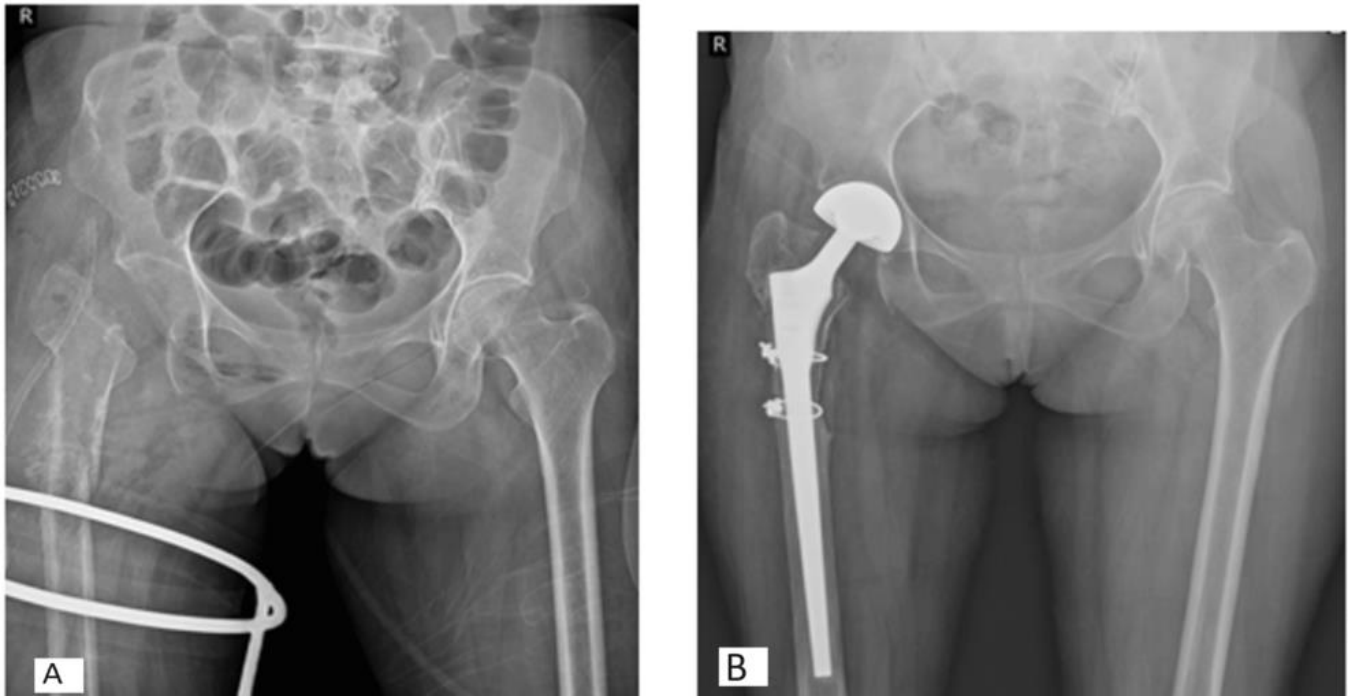

Figure 6: Post operative X - ray image at follow up at 3 months.
(A) Preoperative AP view showing proximal femur shaft fracture with thomas splint insitu, (B) Post operative AP view shows well fixed long stem bipolar prosthesis insitu

4. Discussion

Femoral neck fractures are a common and costly problem, affecting up to 1 in 4 women and 1 in 10 men during their lifetime. [8 - 11] Intracapsular fractures are particularly challenging due to the risk of avascular necrosis, and the success of surgical management depends on the type and quality of surgery performed. [12]

The goal of surgery is to quickly and effectively stabilize the fracture, allowing the patient to bear weight and return to pre - injury function with minimal complications. [13] Various biomechanical constructs can be used, including compression screws, fixed - angle dynamic implants, and blade plates, which promote union and maintain reduction during weight bearing. [14]

5. Findings of this Study

The findings of the present study suggest that there are differences in age between patients treated with CCS fixation and DHS plating for intracapsular neck of femur fractures, with the CCS fixation group being significantly younger. This may be due to differences in bone quality or the severity of the fracture, which could influence the choice of treatment. On the other hand, gender distribution did not differ significantly between the two treatment groups, indicating that both methods are equally suitable for both male and female patients. The distribution of fracture location was relatively even between the left and right sides of the neck of femur, which is consistent with previous studies.

The fact that a relatively high percentage of patients had no co - morbidities may indicate that these patients were generally healthy and had a better chance of a positive outcome following treatment. On the other hand, the relatively high percentage of patients with co - morbidities may suggest that this population is at a higher risk for developing complications, which could influence treatment decisions.

The comparison of operative times between the CCS fixation group and the DHS plating group did not show a statistically significant difference. This implies that neither technique has a clear advantage in terms of operating time.

However, it is worth noting that a higher proportion of patients in the DHS plating group had surgery times of 90 minutes or more (58.3%) compared to the CCS fixation group (41.7%). This could indicate that the DHS plating technique may be more complex and time - consuming than CCS fixation, but this difference did not reach statistical significance.

Comparison with other studies: -

Studies by Al - kelabi AE [15] and Kaplan T [16] found no significant difference in blood loss and radiological union time between MCS and DHS groups, while Yih - Shiunn L [17] reported higher blood loss and transfusion rates in DHS group. Gupta M [18] reported no difference in union rate, but a longer time for radiological union in SHS group compared to CCS group. Kaplan T [16] found no significant difference in union rate between DHS and CCS groups. Most orthopaedic surgeons opt for a dynamic hip screw (DHS) or several cannulated screws for internal fixation (MCS). A less invasive technique that reduces blood loss and soft tissue stripping is osteosynthesis with MCS fixation. The screw - plate system achieves a more stable condition with the use of DHS. [19] The Standard Harris Hip Score (HHS), a validated tool for assessing an individual's functional capacity, has historically been the most popular scoring method used to evaluate a patient with hip pathology both before and after surgery. [20, 21] The current study found that there was no significant difference between the two groups in terms of blood loss, radiological union, and Harris Hip Score. In addition, the study evaluated difference in the means of blood loss, operative time, Harris hip score, and radiological union time. There was no significant differences in these parameters between the two groups. Studies by Al - kelabi AE [15] and Kaplan T [16] found no significant difference in intraoperative blood loss between MCS and DHS groups. However, Yih - Shiunn L [17] reported a significantly greater drop in haemoglobin levels and higher blood transfusion rate in the DHS group compared to MCS group. Harris Hip Score outcomes were similar in the SHS and CCS groups in Gupta M [18], Al - kelabi AE [15], and Kaplan T [16] studies. Siavashi B reported a significant difference in Harris hip score between DHS and CCS groups, which contrasts with the current study's findings.

Various authors have compared the use of CCS and DHS for femoral neck fractures. Al - kelabi AE [15] et al, Kaplan T [16] et al, Yih - Shiunn L [17] et al, Schweitzer D [22] et al,, Siavashi B et al, Widhalm HK [23] et al,, and Arfee S [24] et al have reported similar complication rates between the two groups, with non - union being the most common. However, Widhalm HK [23] et al reported a higher incidence of AVN in the DHS group. Yih - Shiunn L [17] et al found longer hospital stays in the DHS group, but Widhalm HK [23] et al did not. Older age was associated with a higher incidence of complications, as reported by Al - kelabi AE [15] et al and Kaplan T [16] et al. Arfee S [24] et al reported no complications with DHS alone, while Bhaskar SK reported cases et al of osteonecrosis in both groups.

The study also assessed the association between the age of the patients and the occurrence of complications and found no significant difference between the two groups. This suggests that age may not be a determining factor in the likelihood of developing complications following either surgical procedure.

6. Limitations

The study has limited sample size, as the modality of treatment preferred for elderly patients with neck of femur fracture nowadays in most cases is hemi - arthroplasty or a total hip arthroplasty

7. Conclusions

In conclusion, as per currently available study there is no significant difference between the use of the CCS and DHS in the treatment of femoral neck fractures. Both types of fixation have comparable outcomes in terms of radiological union, Harris hip scores, and complications. However, there were some variations in the frequency of certain complications, such as AVN and non - union. It is evident from the present study that both the modalities of surgery give results which are comparable; hence we can conclude that it is the surgical anatomy of the fracture that can decide the modality of surgery that can be performed.

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Appendices

Harris Hip Score

(With the permission of the Journal of Bone & Joint Surgery)

Clinician's name (or ref) ..... **Patient's name (or ref)** .....

Please answer the following questions.

Section 1

Pain	**Support**
○ None, or ignores it	○ None
○ Slight, occasional, no compromise in activity	○ Cane/Walking stick for long walks
○ Mild pain, no effect on average activities, rarely moderate pain with unusual activity, may take aspirin	○ Cane/Walking stick most of the time
○ Moderate pain, tolerable but makes concessions to pain. Some limitations of ordinary activity or work. May require occasional pain medication stronger than aspirin	○ One crutch
○ Marked pain, serious limitation of activities	○ Two Canes/Walking sticks
○ Totally disabled, crippled, pain in bed, bedridden	○ Two crutches or not able to walk

Distance walked	**Limp**
○ Unlimited	○ None
○ Six blocks (30 minutes)	○ Slight
○ Two or three blocks (10 - 15 minutes)	○ Moderate
○ Indoors only	○ Severe or unable to walk
○ Bed and chair only	

Activities - shoes, socks	**Stairs**
○ With ease	○ Normally without using a railing
○ With difficulty	○ Normally using a railing
○ Unable to fit or tie	○ In any manner
	○ Unable to do stairs

Public transportation	**Sitting**
○ Able to use transportation (bus)	○ Comfortably, ordinary chair for one hour
○ Unable to use public transportation (bus)	○ On a high chair for 30 minutes
	○ Unable to sit comfortably on any chair

To score this section all four must be 'yes', then get 4 points. Nb. Not 1 point for each four or nothing.

Section 2

Does your patient have ALL of the following: -

○ yes ○ no	Less than 30degrees of fixed flexion Less than 10 degrees of fixed int rotation in extension Less than 10 degrees of fixed adduction Limb length discrepancy less than 3.2 cm (1.5 inches)

Section 3 - Motion

Total degrees of Flexion	**Total degrees of Abduction**
○ None	○ None
○ 0 >8	○ 0 > 5
○ 8 > 16	○ 5 > 10
○ 16 > 24	○ 10 > 15
○ 24 > 32	○ 15 > 20
○ 32 > 40	**Total degrees of Ext Rotation**
○ 40 > 45	○ None
○ 45 > 55	○ 0 > 5
○ 55 > 65	○ 5 > 10
○ 65 > 70	○ 10 > 15
○ 70 > 75	**Total degrees of Adduction**
○ 75 > 80	○ None
○ 80 > 90	○ 0 > 5
○ 90 > 100	○ 5 > 10
○ 100 > 110	○ 10 > 15

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Nb: This page cannot be saved due to patient data protection so please print the filled in form before closing the window.

The Harris Hip Score is: 0

Grading for the Harris Hip Score

Successful result

=post operative increase in Harris Hip Score of > 20 points + radiographically stable implant + no additional femoral reconstruction

Or

<70 Poor 70 - 79 Fair 80-89 Good 90 -100 Excellent

Reference for Score: Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. J Bone Joint Surg Am. 1969 Jun;51(4):737-55. **Link**

Reference for grading: Marchetti P, Binazzi R, Vaccari V, Girolami M, Morici F, Impallomeni C, Commessatti M, Silvello L. Long-term results with cementless Fitek (or Fitmore) cups. J Arthroplasty. 2005 Sep;20(6):730-7.

Figure 7: HARRIS HIP SCORE [25]