MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.6.360.365

OPEN ACCESS

Key Words
DHS and tip apex distance, harris hip score

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Received: 25 March 2024
Accepted: 30 April 2024
Published:9 May 2024

Citation: T. Shyamdhar, B.M. Irshad Ahmad, Tottu Ramanjaneyulu and Gajendra, 2024. The Effectiveness of the DHS and Tip Apex Distance, Stability, Reduction and Functional Outcome with the Harris Hip Score. Res. J. Med. Sci., 18: 360-365, doi: 10.36478/makrjms.2024.6.360.365

The Effectiveness of the DHS and Tip Apex Distance, Stability, Reduction and Functional Outcome with the Harris Hip Score

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Abstract
In the geriatric population, trivial fall is the most critical cause of nonfatal injuries and hospital admissions. The Proximal femur fractures are divided into three categories: femoral Neck and inter-trochanteric fractures account for 90% and sub-trochanteric fractures occur in 5-10%. This study's cases were collected from patients admitted to the Department of Orthopaedics, Government General Hospital, Kurnool from November 2018 to November 2020. During this period, elderly patients with Intertrochanteric fractures were classified by Boyd and Griffin classification and 30 cases were selected based on the inclusion criteria and were operated with Dynamic Hip Screw. In the present study, most patients were allowed to bear full weight between 12-18 weeks after surgery. The mean duration of full weight-bearing in the present study is 15.16±4.16.

INTRODUCTION

The demographics of world populations are set to change, with elderly individuals making up the bulk of developing countries' people. The maximum hip fracture rates are seen in North Europe and the U.S. and the minimum in Latin America and Africa. Asian countries show intermediate hip fracture rates. With rising life expectancy throughout the globe, the number of elderly individuals is increasing in every geographical region and it is projected that the occurrence of hip fractures will rise from one million in 1990 to six million by 2050[1].

However as three-quarters of the world's total population lives in Asia, it is estimated that the Asian countries will contribute more to the number of hip fractures in the coming years. The highest occurrence of hip fractures in Asia has been reported in Singapore. It is calculated that by 2050 more than 50% of all osteoporotic trochanteric fractures will occur in Asia. This change in the dispersal of hip fractures over different regions of the world narrates that genetic and environmental factors play a role in the etiology of hip fractures[1].

In the geriatric population, trivial fall is the most critical cause of nonfatal injuries and hospital admissions. The Proximal femur fractures are divided into three categories: femoral Neck and inter-trochanteric fractures account for 90% and sub-trochanteric fractures occur in 5-10%[2].

Intertrochanteric fractures readily unite due to broad fracture surfaces, adequate blood supply and rarely non-unions. If proper care is not taken, fractures unite in malposition resulting in shortening, limp and restricted movements. Treatment must also consider adequate internal fixation to help early mobilization and to reduce morbidity[3].

A combination of surgical fixation, early postoperative physiotherapy and ambulation is the best approach. The goal of treating hip fractures is to return the patient to a pre-injury level of function. Among the various internal fixation devices used for trochanteric fractures, the dynamic hip screw with a sliding plate is one of the implants that permit the proximal fragments to collapse or settle, seeking their stability position.

According to the inclusion criteria, in the study period of two years, 30 cases were radiologically classified and treated surgically as early as possible. These fractures were treated with dynamic hip screws and a plate system. A study was undertaken to study the effectiveness of the DHS and Tip Apex distance, stability, reduction and functional outcome with the Harris Hip score[4].

MATERIALS AND METHODS

This study's cases were collected from patients admitted to the Department of Orthopaedics, Government General Hospital, Kurnool from November 2018 to November 2020. During this period, elderly patients with Intertrochanteric fractures were classified by Boyd and Griffin classification and 30 cases were selected based on the inclusion criteria and were operated with Dynamic Hip Screw. Patients and their relatives were explained the condition, informed consent was received and all the patients' details were collected in a proforma.

Following discharge, regular follow-up was done in the outpatient department for 1 year. In case physiotherapy was needed, patients were referred accordingly on an outpatient basis.

Method of Collection of Data:

- By interview
- By follow up at intervals 1st, 3rd, 6th months respectively and 1-year postoperatively
- The cases at follow-up were analyzed both clinically and radiologically and protocols were filled

Inclusion Criteria:

- All elderly patients with intertrochanteric fractures are classified by Boyd and Griffin classification
- The age group of patients between 50-80 years
- Fractures less than 3 weeks old

Exclusion Criteria:

- Patients aged less than 50 years and more than 80 years
- Old malunited fractures
- Unstable intertrochanteric fractures
- Compound fractures which are associated with vessel injury, ipsilateral femur shaft fractures and pelvic injuries

RESULTS AND DISCUSSIONS

The following observations were made from data collected during this study:

The mean and standard deviation of the age of the patients is 68.06±6.1 years. The majority of patients are in the age group 65-70 years in our study.

In the present study, Intertrochanteric fracture incidence was higher in the Female gender (Male: Female is 40:60). In the present study, the Left side was most commonly involved.

In the present study, the most common intertrochanteric fracture pattern belongs to the type of Boyd and Griffith type.

The mean duration of hospital stay for the entire sample was found to be 17.4±3.4 days. Some patients had to stay for a more extended period of 28 days to treat medical conditions and make the patient fit for

Table 1: Distributions of subjects according to age

Age group	Number	Percentage
< 60	0	0
60-65	7	23.3
65-70	12	40
70-75	5	16.7
75-80	3	10
80-85	3	10
Total	30	100

Table 2: Distribution according to boyd and griffin classification

Boyd and Griffin Type	Number	Percentage
Type 1	3	10
Type 2	18	60
Type 3	9	30
Type 4	0	0
Total	30	100

Table 3: Mode of injury

Mode of Injury	Frequency	Percentage
Trivial Fall (T.F.)	23	76.7
Road Traffic Accident (RTA)	4	13.3
Fall from Height (F.H.)	3	10

Table 4: Distribution according to harris hip score at 6 months

Harris Hip Score	Number	Percentage
Excellent [90-99]	0	0
Good [80-89]	13	43.3
Fair [70-79]	4	13.3
Poor [<70]	13	43.4
Total	30	100

Table 5: distribution according to screw position in postoperative x-ray

Screw position in X-ray	Frequency
Central (C)	15
Centero-Posterior (CP)	4
Centero-Inferior (CI)	7
Superior (S)	4

Table 6: distribution according to harris hip score at 1 year

HHS score	Number	Percentage
Excellent	21	70
Good	2	6.7
Fair	5	16.6
Poor	2	6.7
Total	30	100

Table 7: Tip apex distance in boyd and griffin classification

Boyd and Griffin classification	TAD (in centimeters) Mean ± Standard Deviation (S.D)
Type 1	2.2 ±0.43
Type 2	2.13 ±0.29
Type 3	2.15 ±0.24
Type 4	-

Table 8: Distribution of subjects based on postoperative wound status

Postoperative Wound Status	No. of Cases	Percentage
Superficial Infection	2	6.7
Normal healing	24	80
Delayed healing	3	10
Bed sores	1	3.3

Table 9: Distribution of sample by postoperative complications at 6 months-1 year period evaluation

Postoperative Complications	No. of Cases	Percentage
Delayed union	2	6.7
Implant Failure	1	3.3
Shortening (>1.0cms)	7	23.3
Varus collapse	2	6.6

Table 10: Singh's index effect on harris hip score at 6 months

Singh's index grade	Harris hip score Good	Fair	Poor
2	4	1	1
3	7	3	8
4	2	1	3

$X^2 = 2.0299$ p = .730 it is not significant.

Table 11: Distribution of subjects by time taken for full weight bearing

Duration in weeks	No. of Cases	Percentage
9-12	2	6.7
12-15	16	53.3
15-18	9	30
>18	3	10

Table 12: Age incidence compared with other studies

Baumgaertner *et al.*[5]	77 years
Boyd and Griffin	69.7years
RC Gupta[6]	51.2years
Tage sahlstrand[7]	75 years
Ali Sadeghi[58]	76.7 years
R K Kanojia[9]	56.79 years
Bolhofner, Brett R[10]	79 years
Present study	68.06 years

Table 13: Gender incidence compared with other studies

Baumgaertner *et al.*[5]	27: 73
G.S Kulkarni[11]	46: 54
Ian J Harrington[12]	13: 87
R.K Gupta[13]	40: 60
Sanjay Agrawala[14]	29: 71
Present study	40: 60

Table 14: Radiological fracture union in weeks

Radiological Union(weeks)	
Singla G[22]	14
T Satish Kumar[23]	15.3
Present study	15.16

Table 15: Complications in comparison with other studies

	Boldin *et al.*[24]	Pavelka *et al.*[25]	Present study
Bony Union	100%	95%	86.7%
Delayed Union	2%	5%	6.7%
Implant Failure	3.6%	2%	3.3%
Non-union	-	-	-

Table 16: Harris hip score at 1 year

Study	Mean HHS
Yih Shiunn Lee [26]	86.9±5.3
M. Guven and Kjell matre *et al.*[27]	88.9±6.27
Present study	87.5±8.95

surgery and also due to postoperative wound infections.

The most common mode of injury is trivial fall leading to fracture in our study (76.7%).

At the end of 6months, Harris hip score was found good in 43.3% and poor in 43.3%.

The mean and standard deviation tip apex distance for Type 1 Fracture is 2.2±0.43

The mean and standard deviation tip apex distance for Type 2 Fracture is 2.13±0.29.

The mean and standard deviation tip apex distance for Type 3 Fracture is 2.15±0.24.

In the present study, most patients were allowed to bear full weight between 12-18 weeks after surgery. The mean duration of full weight-bearing in the present study is 15.16±4.16.

The present study was done at Government General Hospital, Kurnool, from November 2018 to November 2020. In the present study, 30 cases of intertrochanteric fracture of the femur treated using dynamic hip screw and plate were evaluated.

Patients admitted here were evaluated pre-operatively., details were collected in a preformed proforma, operated on and followed up regularly in OPD.

The data collected in this series are analyzed and compared with other studies.

Age of Incidence: The mean and standard deviation of the age of the patients in this study is 68.06±6.1 years.

The average age is higher in Western countries compared to our country for the following reasons.
The contributing factors for the low average age in Indians will be Protein-calorie malnutrition, Vitamin D deficiency and Osteoporosis.
The life expectancy of people from Western countries is 10 years more than the Indian population.
The study results are comparable with the Boyd and Griffin series.

Gender Incidence: This study has a gender incidence of male to female ratio of 40:60. In the study, there was an increase in the incidence of intertrochanteric fractures in females.
The above studies show there is a strong female predominance due to many
reasons, the main reason being:
The study's females' age suggests they are post-menopausal, which causes Osteoporosis, indicating Decreased Bone Quality and fracture due to trivial trauma. The results of the study are comparable with Gupta[13].

Side Involved: In the present study, out of 30 cases, the Left side was involved in 20 patients and the right side was involved in 10 cases.

Mode of Injury: In this study, the most common cause of intertrochanteric fractures was a trivial fall in about 76% of cases.
Other causes were Road Traffic Accident in about 13% of cases and Fall from Height in about 10% of cases.
These results are comparable with the majority of studies related to intertrochanteric fractures.

Distribution According to Comorbidity: Anaemia and Hypertension were the most common co-morbidity in this study.
Diabetes mellitus, ischemic heart disease and chronic obstructive pulmonary disease were also associated.

Fracture Type Based on Boyd and Griffin Classification: 60% of fractures were Type 2, being the most common.
30% of fractures were Type 3.
10% of fractures were Type 1.
These results are comparable with Arun Kumar Singh *et al*.[15] in which.
Type 2 fractures were common.

Tip Apex Distance: This study shows that 24 patients had a Tip Apex distance of less than 2.5cm and only 6 patients had TAD of more than 2.5cm.
Gupta[13] had similar results in his 64 patients, with 10 patients having Tip.
Apex Distance of more than 2.5cm and 54 patients have a tip apex Distance of less than 2.5cm. The patients with TAD less than 2.5cm had no complications.

Baumgaertner[5], S.G gooi[16], Ali Sedhigi[8] and Ted Tuescu[17], in their studies, have concluded that patients with Tip Apex distance less than 2.5cm had given good results, once again strengthening the fact that Tip Apex distance is a significant predictor of good fracture union and cut-out failure in the management of intertrochanteric fractures using Dynamic Hip Screw.
Kumar and colleagues looked at the significance of hip rotation on Tip Apex Distance (TAD) in the synthetic femur, taken in neutral and varying degrees of hip rotation and position (adduction and abduction). They found statistically significant differences in TADs in AP and Lateral radiographs and suggested avoiding putting the screw through the joint., the hip should be in internal rotation., otherwise, if the screw is placed in external rotation or abduction, there is a danger of putting it straight into the joint.

Position of Lag Screw in Femoral Head: In this study, the post-operative lag screw placement shows that in 15 patients, it is Centrally placed, Superior in 4 patients, Centro-posterior in 4 patients and Centro-inferior in 7 patients.
Patients with the lag screw placed in Central and Centro-inferior positions in the femoral head had good functional outcomes with fracture union and lower cut-out rates of the lag screw.
According to Vinay Parmar[18], the lag screw placement in Central and Inferior positions had given good outcomes.

Migration of the lag screw with a cut-out from the femoral head remains the most common complication after surgical fixation with DHS. The patient's age, bone quality, fracture pattern, the stability of reduction, type and angle of implant and the most important factor is the lag screw in the femoral head.

Parker *et al*.[19] reported that cut-out was more frequent when the lag screw was placed superiorly and anteriorly on AP and lateral radiographs. The highest cut-out rates were found in peripheral zones than the central zone.

Kaufer advised placing the lag screw in the postero inferior quadrant of the femoral head. He concluded that this position of the lag screw should be in the femoral head where the decussation of tension and compression trabeculae occurs to obtain maximum proximal fragment control[20].

Postoperative Wound Status: In this study, around 80% of cases showed routine healing of the postoperative wound.
10% of cases showed delayed healing after intravenous antibiotics for 2 weeks, debridement and secondary suturing due to deep infection of the postoperative wound.
One patient developed a bedsore in the trochanteric region's posterior aspect due to prolonged

immobilization in the same position, which healed with a scar after intravenous antibiotics, debridement and regular dressings.

Duration of Hospital Stay: This study shows that the mean duration for the hospital stay was 17.4±3.4 days. The minimum stay was 7 days and the maximum stay was 28 days due to medical complications.

Tage Sahlstrand[7], in his study in 1974, concludes that the average hospital stay for patients operated with a Dynamic Hip Screw was 56 days. This shows that because of advances in medical facilities and treatment for co-morbidities, the average hospital stay is reduced compared to previous studies.
The average duration of hospital stay in this study was comparable with Richard F Kyle[21].

Fracture Union in Weeks Following Surgery: In the present study, 90% of patients were allowed to fully weight bear between 12-18 weeks following surgery based on radiological signs of the union at the fracture site.
Most studies based on the literature review radiological signs of fracture union in patients following surgery using Dynamic Hip Screw to manage intertrochanteric fractures were between 12-16 weeks. The results were comparable with Satish Kumar *et al*. [23], where the radiological union was 14 weeks following surgery.

Postoperative Complications: In this study of 30 cases, 23.7% cases had Limb Length Shortening of >1cm, 6.7% cases had Delayed union, where there was no evidence of fracture union radiologically for more than 6 months, 6.7% cases developed varus collapse and 3.3% cases had implant failure over 1 year follow up.
These results were compared with the case series of Boldin *et al.*[24] and Pavelka *et al.*[25].

Harris Hip Score at 1 Year: The present study has given Excellent scores in 21 cases out of 30 cases based on the Harris Hip Score at 1-year follow-up. It was also noted that 13 cases out of 30 cases had Poor scores at 6 months follow-up, which improved to Excellent scores at 1-year follow-up based on the Harris Hip Score.
Harris Hip Score helps assess the functional outcome of the management of intertrochanteric fractures. In the present study, the mean HHS was 87.5±8.95, comparable with M. Guven and Kjell matre *et al.*[27].
The functional outcome results show that even today, intertrochanteric fractures treated with dynamic hip screw give good functional results in the elderly.

CONCLUSION

- To conclude, Early surgery on patients with Intertrochanteric fractures improved the ability to return to independent living and prolonged immobilization complications are prevented
- Dynamic hip screw provides good fixation, but success is dependent on many factors like Patient's Age, Bone Quality-Singh's Index, Fracture type, Tip Apex Distance, Post-operative care and Rehabilitation
- This study showed the Dynamic hip screw as a versatile, stable, acceptable implant fixation in intertrochanteric fractures

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