ORIGINAL ARTICLE

Evaluation of tip apex distance in predicting implant failure in stable intertrochanteric fractures of femur managed by dynamic hip screw

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Abstract:

Background and Objectives: Dynamic hip screw (DHS) of femur. The best advantage of fixation is dynamic lag screw which can promote compression at fracture site. Most common complication of dynamic hip screw is implant failure (screw cut out). Tip apex distance (TAD) is most important factor for implant failure (screw cut out). The main objective of this study was to determine the frequency of patients showing tip apex distance (TAD) >25 mm after dynamic hip screw for intertrochanteric fractures of femur and to compare frequency of Implant failure between patients having TAD >25mm versus ≤ 25 mm after dynamic hip screw fixation.

Materials and Methods: A total of 100 patients treated with dynamic hip screw for intertrochanteric fractures of femur, 50 to 70 years of age between 1st Oct. 2015 to 31st Sept. 2016 were included in the study. Patients with fracture shaft of femur, open fracture and polytrauma were excluded. All patients were undergone dynamic hip screw fixation. Frequency of patients with tip apex distance >25 mm were recorded. Patients were followed up regularly at intervals of 3 weeks, 6 weeks, 10 weeks & 14 weeks for presence or absence of implant failure.

Results: Mean age was 62.28±5.02 years. Out of 100 patients, 43 (43.0%) were males and 57 (57.0%) were females with male to female ratio of 1:1.3. Mean duration of fracture was 2.84±2.13 days. Mean tip apex distance was 27.15±8.92 mm. All the patients were undergone dynamic hip screw for intertrochanteric fractures of femur and tip apex distance >25mm was found in 41 patients i.e. 41.0%. Patients with tip apex distance (TAD) of > 25 mm after dynamic hip screw for intertrochanteric fractures of femur showed implant failure in 17 (41.46%) cases compared to 02 (3.39%) in those with tip apex distance (TAD) of ≤ 25 mm (p-value = 0.000).

Conclusion: This study concluded that frequency of patients showing tip apex distance (TAD) >25 mm after dynamic hip screw for intertrochanteric fractures of femur is high and frequency of implant failure is high with TAD >25mm compared to ≤25 mm after dynamic hip screw fixation.

Keywords: Intertrochanteric fracture, dynamic hip screw, tip apex distance, implant failure

Introduction:

A hip fracture is usually a femoral fracture that occurs in the proximal end of the femur (the long bone running through the thigh), near the hip.[1] There are two types of hip fractures i.e. intracapsular and extra capsular. The intracapsular includes femoral head and neck fractures while extracapsular includes trochanteric, intertrochanteric and sub-trochanteric fractures. The prognostic factors depends upto the type of fracture, its location as well as physical condition of the patient. The more communication and co-morbidities the more morbidity of the patient.[2] The etiology of proximal femur in adults is different from young. The fractures in elderly are mostly affected after history of fall or minor or low energy motor vehicle accidents while in young it is because of the high energy

road traffic accidents mostly. The other causes in adults may be rare conditions like Gaucher disease, fibrous dysplasia or bone cysts.[3]

Most of the patients presented and admitted at hospital with intertrochanteric fractures are elderly population and their history mostly include fall.[4] The age of such patients are usually above 6th decade. While considering male and female ratio of elderly, the fractures are 3 times more common in female as compared to males.[5] The proper management of such patients is the surgical intervention not conservative. The surgical procedure have the advantage of early mobilization thus preventing the victims from complications of prolonged immobilization.[6] Among the surgical procedure, the rigid fixation is required for better outcomes. Many devices has been used for these types of fractures but the most reliable devices are the dynamic hip screw. Most of the devices failed because of their complications like screw cut out. Dynamic hip screw remained the treatment option of choice because of its low rate of screw cut out.[2] It is perfomed under image intensifier, firstly close reduction done and then internal fixation done.[7] The maximum and good results after this usage of this implant depends on different factors like pre operative planning, good antibiotics and excellent operative techniques and skills of the surgeons.[8] The best advantage of fixation is dynamic lag screw which can promote compression at fracture site. Most common complication of dynamic hip screw is implant failure (screw cut out).[9] Tip apex distance (TAD) is most important factor for implant failure (screw cut out).[7] Tip apex distance is calculated on x ray using Baumgaertner formula. It is the sum of distance in millimeter from tip of implant to apex of femoral head on standard antero-posterior and lateral x-rays of the hip.[10] A tip apex distance (TAD) of more than 25 mm is associated with increased risk of implant failure.[8,11] A study has found that patients with tip apex distance (TAD) of > 25 mm after dynamic hip screw for intertrochanteric fractures of femur showed implant failure in 44.0% cases compared to 0.0% in those with tip apex distance (TAD) of ≤ 25 mm.[11] A study done by ImadudinS et al,[12] on 80 patients with intertrochanteric fracture of femur concluded that tip apex distance >25mm was found in 30 patients i.e. 37.5%.[9]

Through this study, we would be able to find out the tip apex distance (TAD) of > 25mm after dynamic hip screw for intertrochanteric fractures of femur as the main predictor of implant failure, by comparing with control group having tip apex distance (TAD) of ≤ 25mm. This study would provide baseline local statistics. It would also help in deciding whether further recommendations, with regards tip apex distance screening, should be implemented in all patients treated with dynamic hip screw for intertrochanteric fractures of femur. Therefore, this study would be of clinical importance in planning prevention and therapeutic strategies.

Materials and Methods:

This study is a descriptive, case series study conducted at Department of Orthopaedic & Spine Surgery, Ghurki Trust Teaching Hospital, Lahore from 1st October 2015 to 31st September 2016 after approval from hospital ethical committee. The sample size of 100 cases using non-probability, consecutive sampling was calculated by taking 95% confidence level, 10% margin of error and taking expected percentage of patients showing tip apex distance >25mm i.e. 37.5% 12 after dynamic hip screw for intertrochanteric fracture of femur. An informed written consent was taken from the patients prior to enrollment in the study. Patient's name, age, sex and address were entered in a pre-designed proforma attached herewith. All information about patients was kept confidential. All patients were undergone dynamic hip screw fixation by one consultant Orthopaedic surgeon (with at least 5 years of post-fellowship experience). Frequency of patients with tip apex distance >25mm were recorded. Patients were followed up regularly at intervals of 3 weeks, 6 weeks, 10 weeks & 14 weeks for presence or absence of implant failure (as per-operational definition). Patients were mobilized with walker with touch-down weight bearing on 5th post-operative day, partial weight bearing with walking frame between 3-4 weeks and full weight bearing without support after 6

Table 1: *Comparison of Implant failure between both Groups*

		≤25 mm (n=59)		>25 mm (n=41)		
		Frequency	**%age**	**Frequency**	**%age**	**P-value**
Implant Failure	Yes	02	3.39	17	41.46	0.000
	No	57	96.61	24	58.54	

Table 2: *Stratification of implant failure in both groups according to age of patients*

Age of patients (years)	**≤25 mm (n=59)**		**>25 mm (n=41)**		**P-value**
	Implant Failure		**Implant Failure**		
	Yes	No	Yes	No	
50-60	01 (4.76%)	20 (95.24%)	07 (29.17%)	17 (70.83%)	0.033
61-70	01 (2.63%)	37 (97.37%)	10 (58.82%)	07 (41.18%)	0.000

weeks.

Sample selection:

Inclusion Criteria: All patients treated with dynamic hip screw for inter-trochanteric fractures of femur as per-operational definition. Patients of both genders aged between 50-70 years.

Exclusion Criteria: Patients with fracture shaft of femur (assessed on x-rays). Patients with bone mineral density < 2 standard deviation on DEXA scan. Open inter-trochanteric fractures (assessed on clinical examination) with breach in the skin. Patients with polytrauma (assessed on radiograph).

Statistical Analysis:

Data was entered and analyzed using SPSS-17. Descriptive statistics were applied to calculate mean and standard deviation for quantitative variables like age, duration of fracture, BMI and tip apex distance. Frequencies and percentages were calculated for qualitative variables like gender, number of patients showing tip apex distance >25mm and implant failure (present/absent). Chi-square test was used to compare the implant failure in both groups i.e. tip apex distance (TAD) >25mm and ≤25mm, after dynamic hip screw for intertrochanteric fractures of femur. P-value less than or equal to 0.05 ($p \leq 0.05$) was considered as significant.

Results:

Age range in this study was from 50 to 70 years with mean age of 62.28±5.02years. Majority of the patients 55 (55.0%) were between 61 to 70 years of age. Out of 100 patients, 43 (43.0%) were males and 57 (57.0%) were females with male to female ratio of 1:1.3. Mean duration of fracture was 2.84±2.13 days and mean BMI was 31.31±6.49 kg/m^2. Mean tip apex distance was 27.15±8.92 mm.

All the patients were under-gone dynamic hip screw for inter-trochanteric fractures of femur and tip apex distance >25mm was found in 41 patients i.e. 41.0%. Patients with tip apex distance (TAD) of > 25mm after dynamic hip screw for inter-trochanteric fractures of femur showed implant failure in 17 (41.46%) cases compared to 02 (3.39%) in those with tip apex distance (TAD) of ≤ 25mm (p-value = 0.000) as shown in table 1.

Stratification of TAD >25mm and comparison of the implant failure in both groups i.e. tip apex distance (TAD) >25mm and ≤25mm with respect to age of patients is shown in Table 2. There is statistically significance in patient with age 61- 70 years.

Discussion:

Femoral fractures involving the trochanteric area are the commonest of all fractures in elderly.[13] The higher morbidity and mortality associated with this type of fracture is due to its long immobilization. To overcome this problem, the patient has to be mobile as soon as possible.[1] It can only be achieved when there is stable fixation, less pain and highly stable patients. Different surgical implants had been introduced for stable fixation like sliding hip screw, intramedullary nail, trochanteric locking plate, fixed angle blade plate and dynamc condylar plate.[13,14] Among all of them, the Dynamic hip screw fixation is considered as superior than other because of its stability.[15] Anglen et al found that from 1999 to 2006, for fixation of trochanteric fractures, there was a dramatic increase in the preference for the use of intramedullary nails that interlock proximally into the femoral head, in comparison with the use of a sliding compression screw.[16] The intramedullary nail fixation rate rose from 3% in 1999 to 67% in 2006. Overall, patients managed

with plate fixation had slightly less pain and deformity than those managed with intramedullary nailing, and no significant differences were identified with regard to function or patient satisfaction. In addition, the authors found that patients managed with intramedullary nailing had more procedure-related complications, particularly femoral shaft fracture.[16] They noted that this change in management of trochanteric hip fractures occurred despite a lack of evidence supporting the change and the apparent potential for increased complications and cost.

Bhandari et al performed a meta-analysis to identify the risk of femoral shaft fracture associated with short cephalo-medullary nails after treatment of extracapsular hip fractures. They found that in studies published between 1991 and 2000, gamma nails increased the risk of femoral shaft fracture by 4.5 times when compared with compression screws. According to Bhandari et al, the more recent trials suggest that the increased femoral shaft fracture risk associated with gamma nails has been resolved as the result of improved implant design and better surgical technique.[17]

Sidhu et al studied 53 patients average age, 77 years, after total hip replacement for trochanteric hip fractures. In the study patients, the Harris hip score at 1 month was 66±7; at 3 months, 72±6; at 1 year, 74±5; at 3 years, 76±6; and at the completion of 5-year follow-up (27), 76±8.[18] The average time to return to normal daily activities was 28 days (range, 24-33 days), and no loosening or infection was observed. Sidhu et al concluded that in mentally healthy elderly patients with trochanteric hip fractures, total hip arthro-plasty may be a valid treatment option because it offers the potential for quick recovery with little risk of mechanical failure, it avoids the risks often associated with internal fixation, and it can enable patients to maintain a good level of function immediately after surgery.[18]

Subsequent studies have shown that the dynamic helical hip system results in outcomes that are comparable to those achieved with the dynamic sliding hip screw, and its blade is more resistant to vertical or rotational displacement.[19,20]

In this study, age range was from 50 to 70 years with mean age of 62.28±5.02 years. Majority of the patients 55 (55.0%) were between 61 to 70 years of age. Out of 100 patients, 43 (43.0%) were males and 57 (57.0%) were females with male to female ratio of 1:1.3. All the patients were under-gone dynamic hip screw for intertrochanteric fractures of femur and tip apex distance >25mm was found in 41 patients i.e. 41.0%. Patients with tip apex distance (TAD) of > 25mm after dynamic hip screw for intertrochanteric fractures of femur showed implant failure in 17 (41.46%) cases compared to 02 (3.39%) in those with tip apex distance (TAD) of ≤ 25mm (p-value = 0.000).

Although earlier studies[21] showed that patients who have a tip apex distance >25mm are at risk of screw cut out, while another study[22] found a threshold value for tip apex distance at the 19.9-mm level. The 19.9mm threshold thus proves to be a better predictor (although not significantly) than the 25mm threshold. The 25mm threshold, as stated in the study of Baumgaertner et al,[21] is significantly more reliable in predicting that a screw will not cut out. In his retrospective review of 198 peri-trochanteric fractures, a TAD of< 30mm had a 2% rate of cut out, compared with a 27% rate of cut out with a TAD > 30 mm, 36% rate of cut out with a TAD > 35mm and a 60% rate of cut out with a TAD > 45mm. A similar observation was noted in another study, out of 8 implant failure cases 5 (62.5%) of them had TAD >30mm.[23]

A recently published systematic review concluded that a TAD of more than 25mm increases the risk of lag screw cut through by more than 10 times.[24] Another study further substantiates these observations as all six patients who required DHS revisions had a TAD of more than 25mm. A TAD of more than 25mm suggests that a lag screw is not centrally placed within the femoral head and, therefore, it is more likely to erode through the bone over time.[25]

25mm is the cut off value to prevent implant fail-

ure in DHS in most of the studies and should be considered while doing this procedure. Few limitations in our study were that we didn't taken a large sample size. More over we didn't follow up the patients for longer time. So, further studies needed at national level for better results in population of Pakistan.

Conclusion:

We conclude that frequency of patients showing tip apex distance (TAD) >25mm after dynamic hip screw for inter-trochanteric fractures of femur is high and frequency of implant failure is high with TAD >25mm compared to ≤25 mm after dynamic hip screw fixation.

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Role and contribution of authors:

Dr Muhammad Umair, collected the references, data and did the initial write up.

Dr Rizwan Akram, helped in collecting the data and references and critically went through the article.

Dr Ashfaq Ahmed, helped in collected the data, and helped in introduction and material and methods writing.

Dr Ijaz Ahmed, helped in writing introduction, data collection and discussion.

Dr Atiq Uz Zaman, helped in writing introduction and discussion.

Dr Naeem Ahmed, helped in collecting the data and references.

Dr Amer Aziz, critically went through the article and made the final changes.

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