Original Research Article

Effect of screw neck angle and screw parallelism in fixation of fracture neck of femur by partially threaded cancellous screws

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Abstract

Aims: The objective of this study was to investigate and evaluate the effect of screw parallelism and neck screw angle on functional outcome and prognosis of femoral neck fractures in young adults ficed closed with Partially Threaded Cancellous Screws (PTCS). **Patients and methods:** Here are presented 64 patients, both retrospective and prospective who were treated with closed reduction and internal fixation with PTCS. Ages of the patients ranged from 18-59 years. The patients were followed up for a minimum period of one year and the functional results were assessed with the help of modified Harris hip score and the Oxford hip score. Apart from general complications, the study was focussed on the two most dreaded complications of fracture neck femur, osteonecrosis and non union. **Results:** Most of the patients with parallel (90.7%) and divergent (68.8%) configuration of screws had excellent to good scores. 90.6% of the patients with parallel screw configuration and 87.5% of the patients with divergent screw configuration did not develop osteonecrosis. Both these correlations were found to be significant (p value <0.05). similar results have been seen with screw neck angle, a new parameter which has not been used before in any of the studies available in the literature. **Conclusion:** The role of screw parallelism and neck screw angle in predicting functional outcome and guiding the treatment is significant and needs further investigation to reaffirm its role in the same.

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INTRODUCTION

Hip fractures are common and comprise about 20% of the operative workload of an orthopaedic trauma unit. Intracapsular femoral neck fractures account for about 50% of all hip fractures[1].Femoral neck fractures have all the problems associated with healing of intracapsular fractures elsewhere in the body. The portion of the femoral neck that is intracapsular has essentially no cambium layer to participate in peripheral callus formation in the healing process[2]. Therefore, healing in the femoral neck area is dependent on endosteal union alone[3], which is one of the reasons that prolonged union times are commonly seen in these fractures. Unless the fracture fragments are carefully impacted, synovial fluid can lyse the blood clot formation[4] and thereby destroy another mode of secondary healing by prevention of formation of cells and scaffolding that would allow for vascular invasion of the femoral head. In 1960, Claffey concluded that in all femoral neck fractures that communicate with the point of entry of the lateral epiphyseal vessels, aseptic necrosis occurred[5]. In addition to the specific biology of the fracture healing and the typical vascularity of neck of femur, the displacement of the fracture fragments can render them avascular. Hence

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survival of the femoral head and fracture union is largely dependent on preservation of what is left of the blood supply. Union can still occur through some avascular fragments also but it is prudent to that an accurate and stable reduction is achieved.[6] In the young adult, that is less than 60 years of age, the preferred treatment is internal fixation while in elderly it is total or hemiarthroplasty[7]. There is little consensus in the literature regarding the optimal treatment of this injury, although its vastly believed that other than injury and displacement factors, the fracture reduction, posterior comminution and implant positioning is very important[8]. Commonly used implants for fixation are partially threaded cancellous screws (PTCS) or sliding hip screw (SHS)[9]. Also very recently Dynamic Locking Blade Plate (DLBP) has been used in a study by Kalsbeek *et al* in Netherlands and showed good results.[10] Many surgeons prefer to use PTCS in the treatment of femoral neck fractures considering its many advantages like compression at fracture site, less voluminous implant, collapse-allowing etc. However, there seems to be a severe dearth of literature that details the radiological parameters that govern the optimal position of PTCS on the radiographs and their relative configuration in order to achieve a desirable outcome. In this study we aim to delineate various such parameters pertaining to PTCS in the closed reduction internal fixation of fracture neck of femur and hopefully give substantial evidence to their better use in the future.

MATERIAL AND METHODS

Study design: 39 retrospective and 25 prospective (total 64) cases that were treated by closed reduction internal fixation of fracture neck of femur at our institute in the last 6 years. Institutional ethical board approval was obtained for the same.

Patient selection: patients in the age group of 18-59 years who had a fracture of the neck of femur and treated with closed reduction internal fixation with PTCS. Pathological fractures and fractures operated with open reduction were excluded from the study to reduce the confounding factors. Patients underwent surgery after complete work up and clearance from the anaesthesia department. Patients were discharged on the 5th day after 2 dressings on the 2nd and 5th day. Suture removal done on 14th day and patient allowed partial weight bearing with crutches on 6 weeks follow-up, whence forth 6 weekly x-rays were taken and weight bearing increased gradually. At each visit patients were assessed using both the Modified Harris Hip Score (HHS) and Oxford Hip Score (OHS).

Radiological Assessment

Screw neck angle was measured as the angle which the long axis of the neck of femur (whiteline) makes with the long axis of the screw (black line) in the anteroposterior x-ray view. It was calculated for each screw and divided into three groups based on the highest value obtained (figure 1).

Figure 1

RESULTS

Out of total 64 patients, the age ranged from 18-65 years with maximum age of 59 years and minimum of 18 years. Most of the patients were between the age of 40-59 years constituting more than 50% of the total population. The mean age in our study was 43.3±8.1 years. Maximum number of patients (82%) had a screw neck angle of less than 5 degrees. 18% of the patients had an angle more than 5 degrees. It was found in our study that patients with screw neck angle less than five degrees had a better outcome as compared with those who had screw neck angle more than 5 degrees and this correlation was found to be significant with a p value of 0.020 (table 1)Eighty two percent of the patients had a parallel arrangement of screws or were divergent. In 18% of patients, screws were convergent. Most of the patients with parallel (90.7%) and divergent (68.8%) configuration of screws had excellent to good scores. Significant correlation was found on comparison of screw parallelism with Modified Harris hip score with a p value of 0.047 (table 2). There were 5% cases of non union which did not show any significant results with any of the parameters under study. About ninety six percent of the patients with screws parallel to the neck did not have any signs of osteonecrosis while 75% of those with neck screw angle between 1 to 5 degrees did not have any osteonecrosis. This correlation between neck screw angle and the incidence of osteonecrosis was found significant with a p value of 0.019 (Table 3) 90.6% of the patients with parallel screw configuration and 87.5% of the patients with divergent screw configuration did not develop osteonecrosis. The correlation was found to be significant (p value 0.019) (Table 4).

Table 1: Modified Harris hip score in relation to screw neck angle

Screw neck angle	Modified Harris Hip Score					p Value
	>90	80 - 89	70 - 79	60 - 69	<60	
0 Degrees	19 (73.1%)	4 (15.4%)	1 (3.8%)	1 (3.8%)	1 (3.8%)	0.020
1-5 Degrees	14 (58.3%)	4 (16.7%)	6 (25.0%)	0 (0.0%)	0 (0.0%)	
More than 5 degrees	3 (27.3%)	3 (27.3%)	1 (1.9%)	2 (18.2%)	2 (18.2%)	
Total	**36 (59.0%)**	**11 (18.0%)**	**8 (13.1%)**	**3 (4.9%)**	**3 (4.9%)**	

Table 2: Correlation of Modified Harris Hip score with screw parallelism showing significant results

Screw Parallelism	Modified Harris Hip Score					p Value
	>90	80 - 89	70 - 79	60 - 69	<60	
Parallel	23 (71.9%)	6 (18.8%)	1 (3.1%)	1 (3.1%)	1 (3.1%)	0.047
Divergent	10 (62.5%)	1 (6.3%)	4 (25.0%)	0 (0.0%)	1 (6.3%)	
Convergent	3 (27.3%)	3 (27.3%)	3 (27.3%)	2 (18.2%)	0 (0.0%)	
Total	**36 (61.0%)**	**10 (16.9%)**	**8 (13.6%)**	**3 (5.1%)**	**2 (3.4%)**	

Table 3: Osteonecrosis in relation to screw neck angle

Screw neck angle	Signs of osteonecrosis		p Value
	Present Frequency	Absent Frequency	
0 Degrees	1 (3.8%)	25 (96.2%)	0.010
1-5 Degrees	6 (25.0%)	18 (75.0%)	
More than 5 degrees	5 (45.5%)	6 (54.5%)	
Total	**12 (19.7%)**	**49 (80.3%)**	

Table 4: Osteonecrosis in relation to screw parallelism

Screw Parallelism	Signs of osteonecrosis		p Value
	Yes	No	
Parallel	3 (9.4%)	29 (90.6%)	0.019
Divergent	2 (12.5%)	14 (87.5%)	
Convergent	5 (45.5%)	6 (54.5%)	
Total	**10 (16.9%)**	**49 (83.1%)**	

DISCUSSION

Upadhyay *et al*[11] and Wongwai *et al*[12] concluded that the screws should be placed in a parallel configuration in both the anteroposterior and lateral views in order to achieve the best results. Swiontkowski *et al*[13,14] has earlier reported better results with divergent screws also but the criss-cross pattern in the study by Upadhyay *et al*[11] was similar to divergent screws and it was concluded to decrease the stability of the fixation. Hence, they are best placed parallel[15] and different types of angled jigs have been designed to achieve this. In addition, the screws should be placed just adjacent to the calcar and the posterior cortex[16]. Twenty nine patients (90.7%) with parallel screw arrangement and 11 patients (68.8%) with divergent screw arrangement had excellent to good Modified Harris hip scores as compared to when they were convergent (6 patients or 54.3%). This comparison was found out to be significant in our study (p value 0.047). Oxford hip score was found to be excellent to good in 45 patients (93.75%) with parallel or divergent screw arrangement while it was poor in 2 patients (4.16%). In patients with convergent screw arrangement excellent to good scores were seen in 9 patients (81.9%) while it was poor in none of the patients. This correlation was not found to be significant. This parameter has not been assessed in previous studies in comparison with Modified Harris hip score or Oxford hip score. To the best of the knowledge of the authors, there was not any research article that has stressed on the importance of screw neck angle and its significance in treatment and prognosis of femoral neck fractures. The theory that the authors hypothesize that screw neck angle can be used as a new different parameter to evaluate our fixation both intraoperatively and postoperatively as has been shown by the significant statistics in our results. Simply put, both screw parallelism and neck screw angle are two sides of the same coin which is the situation of the PTCS inside the neck of femur, which is instrumental in the quality of fixation that we can achieve and both can serve as a prognostic indicator towards the complications and functional outcomes in the future. The major limitation of our study was the small sample size and a comparatively shorter follow up in both prospective and retrospective nature of study. A prospective study with large sample size and longer follow up may help us to arrive at better conclusions in the future.

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