ORIGINAL ARTICLE

Outcome of AO Screw Fixation for Intra-Capsular Neck of Femur Fracture

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ABSTRACT

Objective: To assess the outcome of AO screw fixation for intra-capsular neck of femur fracture.

Method: This Quasi experimental study was performed at the Orthopaedic and Trauma Unit, Khyber Teaching Hospital Peshawar from June 2014 to June 2017. All the patients had acute intra-capsular neck of femur fracture at the time of presentation. Garden's classification was used to stratify patients. On antero-posterior and lateral imaging Garden's alignment index used to evaluate anatomic reduction for fractures. All patients underwent AO Screw because its minimally invasive and time-tested device fixation. Postoperative complications were evaluated during follow up periods and followed for eighteen months to two years. The outcome of fixation was assessed in terms of avascular necrosis of head of femur, non-union and need for secondary procedures.

Results: The study comprised total of 55 patients. There were 43 (78.18%) males and 12 (21.82 %) females. Majority 38 (69.03%) suffered from intra-capsular neck of femur fracture secondary to fall. In 31(56.26%) Right hip fractured while in remaining Left side. At the end of study period 46 (83.63%). patients healed un eventfully while 06(10.90%) patients suffered from avascular necrosis (AVN) of the head of femur. In 02(3.63%) Screws were cut out while in 01(1.8%) patient fibular strut graft was needed along with revision of AO Screw fixation to manage non-union.

Conclusion: Intra-capsular displaced neck of femur fracture (Garden type two and three) fixation with AO Screw produces remarkable results in good hip function less than 60 years old. However, there is a high chance of complications if fracture not reduced anatomically.

Keywords: Neck of femur Fracture, AO Screw, Avascular necrosis, Nonunion

INTRODUCTION

In elderly population, commonest fracture is fracture neck of femur (NOF) [1]. These fractures are difficult to treat and treatment results are not entirely satisfactory even today [2]. Minor to moderate amount of trauma can lead to this fracture in elderly but high energy trauma is needed to produce this fracture in younger patients. In association of this fracture there is high morbidity and mortality. This fracture is associated with immobilization, skin problems, chest and gut dysfunction, sensorial dysfunction, thrombo-embolic events, non-union and avascular necrosis of head of femur [3, 4]. One-year mortality in association with this fracture is 14 to 48% [3,5,6].

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The aim of the treatment varies according to the age of patient. In young patients, to achieve early union, prevent deformity and regain the pre-injury mobility status is the aim of treatment. In elderly goal of treatment is early mobilization, functional restoration and prevention of complications [2,4]. The operative choice is between internal fixation (IF) and prosthetic replacement [7]. Prosthesis are commonly used for elderly patients and choice lies between hemiarthroplasty, bipolar arthroplasty and total hip replacement (THR) [6]. Hemiarthroplasty by Austin Moore prosthesis (AMP) is less expensive. Its advantages are that patients are allowed immediate weight bearing so they return earlier to activity avoiding complication of decumbency, inactivity, avascular necrosis and non-union. In addition, the rate of reoperation is lower in older patients treated by hemi-arthroplasty as compared to internal fixation [4,6].

However, AO fixation if performed properly and as soon as possible after intra-capsular neck of femur fracture is associated with good outcome and is the

highly recommended approach in young patients as replacement arthroplasty carries a lot of complications in young patients including need for revision arthroplasty.

The aim of this study was to evaluate the outcome of AO screw fixation for neck of femur fracture in less than 60 years old individuals in terms of facture union and need for secondary procedures.

METHODS

This qausi experimental study was conducted from July 2014 to June 2017 included 55 patients. Inclusion criteria was acute neck of femur fracture (fracture occurred with in 72 hours) and were of age 10 years or older less than 60 years at the time of presentation and Garden type II & III fracture Patients who were bed ridden before the injury, those with pathological fractures, open neck of femur fractures, those unfit for anaesthesia, patients with dementia and those with fracture duration more than one month were excluded from the study.

A detail history obtained from all the patients admitted through emergency or outpatient department, followed by complete physical examination. Patients were interviewed about their pre-fracture ambulatory status and any disabilities. Radiographs were obtained and femoral neck fracture were categorized into four types according to Garden's classification. Treatment options were discussed in detail to the patient and their relatives. The operation of AO Screw fixation was explained to them with the potential benefits and risks in detail and an informed consent was taken. All patients were operated on the as soon as possible basis but not in the evening rather same day or next morning policy. General or spinal anaesthesia was used according to the anaesthetist assessment and choice and fitness of the patient Non-cannulated AO screws were fixed about 3 in number in all cases after close reduction. Patients were operated in a supine position on the traction table, close fracture reduction under image intensifier performed. Under image guidance, a point was marked on the skin on the lateral side of the proximal femoral region. The incision was given and a guide wire was passed and three 6.5mm non-cannulated screws (AO/ASIF synthesis 16 or 32 mm thread length as per AO principles) used to fix the fracture. on average 3 screws fixed in a way to pass the threads beyond fracture line to achieve compression. The next morning patients were allowed to sit with the input from physiotherapist. Patient were kept completely non-weight bearing for the first one and a half month after operation. which may be needed to extend till 03 months. The intravenous antibiotics were continued for 24 to 48 hours followed by oral anti-biotics for 02 weeks Co-Amoxiclavocillin. Post operatively a check x-ray was done before discharging patient home to confirm the proper positioning of the AO Screws.

The total follow up period was eighteen months to two years. Patients from local areas were followed up after 02 weeks for removal of skin stitches while patients from far areas advised to have a wound check and skin stitches removed in their local hospital. Further follow up visits were scheduled at 06 weeks, 03 months and then every 06 monthly for 18 months to 02 years post operatively. Antero-posterior and lateral radiographs were taken and, absence of gap in the fracture line and presence of the bony trabeculae across the fracture region were considered as bone union. Absence of the above two points after a period of 6 months was defined as non-union [9]. To judge the AVN, the Ficat and Arlet radiological criteria were applied [10].

The data was recorded and analyzed using SPSS (Statistical package for social sciences) version 10. Frequencies and percentages were presented for all qualitative variables

RESULTS

This study comprised of 55 patients were intra-capsular neck of femur fracture who underwent AO Screw fixation. Garden alignment index was the criteria used for fracture reduction before fixation. The follow up period was eighteen months to two years. The Patients demographics is summarized in table 01. Distribution of the age of patients in study group is presented in table 02. Majority of the patients suffered from Right side Neck of femur fracture (Table 03). 28 Patients (50.9%) suffered from intra-capsular neck of femur fracture secondary to fall, may be from hills, moving vehicle etc., while others due to direct or indirect hit in road traffic accidents (RTA) (Table 04).

In this study 46 (84%) of patients with intra-capsular neck of femur fracture healed uneventfully while remaining suffered from complications (Table 05). Majority of failed cases suffered from Avascular Necrosis of Head of femur i-e 6/9 (67%), while in others Screw cut-out and Non-union occurred (Table-06).

Patients who suffered from Screw cut-out and Non-union of neck of femur managed with revision

fixation and fixation plus fibular strut graft respectively. Only One patient who suffered from non-union was a young girl of about 23 years suffering from rheumatoid arthritis started early weight bearing mobilisation.

Table 1: Demographic data of the patients

Variable	No.	%
Gender (Total =55)		
Male	43	78
Female	12	22
Total 55 100		

Table 2: Age of patients with neck of femur Intra capsular hip fracture

Age of patient	No. of cases	%
Less than 20 years	22	40
20-40 years	17	30.9
40 and above	15	27.27
Total	55	100

Table 3: Side of fracture neck of femur

Fracture side	No. of patients	%
Right	31	56
Left	24	44
Total	55	100

Table 4: Mechanism of fracture Neck of femur

Mechanism of fracture	No. of patients	%
Fall	28	50.9
Road Traffic Accident	16	29
Fire arm injury (FAI)	01	2
Total	55	100

Table 5: Outcome of fracture neck of femur fixed with AO Screws

Outcome	No. of patients	%
Healed satisfactorily	46	84
Suffered from Complications	9	16
Total	55	100

This young girl was re-operated with AO-Screw fixation with fibular strut graft to augment fixation which worked and fracture healed. Similarly, who suffered from Avascular necrosis of head of femur only in one patient Total Hip Replacement (THR) performed, while others are able to manage with pain management and wait and see policy (Table-07). Similarly, keeping in mind the very young age of these patients (with AVN), very high chance for revision arthroplasty due to early wear and tear of the prosthesis and cost of prosthesis Total Hip Replacement (THR) is not a very valid option, therefore these patients may be candidate for girdle stone procedure in future when pain management fails.

Table 6: Pattern of complicated outcome (failed) cases of fracture neck of femur

Complications pattern	No. of patients	%
Avascular Necrosis Femoral Head (AVN)	06	67
Screw cut out	02	22
Non-Union	01	11
Total	09	100

Table 7: Management of complications of AO Screw fixation for fractured Neck of Femur

Complication	No. of Patients	Management
Cut out Screw	02/09 (22%)	Fixation Revised
Non-union	01/09 (11%)	Revision fixation plus Fibular strut graft
Avascular necrosis (AVN)	06/09 (67%)	T H R in 01 patients (01/06) Pain management with wait and see in 05 patients (05/06)

DISCUSSION

In young patients with intra-capsular neck of femur fracture, treatment of choice is accurate fracture reduction and stabilization with special emphasis on preservation of the blood supply to the head of femur [8]. Associated with neck of femur fracture in young patients, there is a high risk of complications as a consequence of high-energy trauma [8, 9].

The characteristics blood circulation and the absence of cambium layer of the periosteum makes the intra-capsular neck of femur fracture prone to avascular necrosis (AVN) and nonunion [10]. Neck of femur fracture fixation with the screws shows a failure rate of about 5–30% [11,12,13], and the failed cases demand another surgery mostly.

The outcome of the neck of femur fracture fixation is dependent upon several factors. According to the many authors, these factors are degree of fracture displacement, the accuracy of reduction, the time interval between injury and surgical fracture fixation, the configuration of internal fixation and the degree of crushing of the posterior cortical bone [14,15].

In his study of 470 neck of femur fractures, Parker [16] reported that postoperative nonunion occurred in 13% of patients, and out of the 13% who suffered from non-union, 17% patients had displaced fractures i-e Garden stage III, IV while 8% were patients with non-displaced fractures i-e Garden stage I, II ($p<0.005$). From this study, he recommended that the pre-operative degree of displacement of the fracture neck of femur was the most important factor to predict postoperative nonunion along with the classification of fractures, in determining treatment methods. Although, basis of the Garden classification is the degree of the bone fragments displacement and is considered excellent. However, Garden classification has limitations in that it does not consider anatomical classifications of neck of femur fracture which can reflect the fact that the degree of displacement of a fracture does not exactly coincide with x-rays findings in sub-capital fractures and the differences in prognosis between sub-capital and trans cervical neck of femur fractures. Similarly, this classification produces a large inter-observer differences [17].

Survival of femoral head is dependent upon its blood supply. If the broken bone fragments of neck of femur rotated during either fracture reduction or insertion of the fixation devices, blood vessels will be blocked, which leads to avascular necrosis (AVN), which is one of the most common complications of fracture neck of femur, with its frequency of occurrence of 15-40% [18]. In our study, 06(11%) patients suffered from avascular necrosis (AVN) of the head of femur in spite of great care in fracture reduction and fixation which can be explained on the basis that blood vessels supply to the head of femur gets interrupted on the spot of incident which if fail to recover with fixation lead to AVN ultimately. Similarly, Avascular necrosis (AVN) is also affected by the period interval from fracture to its surgical fixation, and maintaining the integrity of the remaining blood vessels during the time between the initial injury and the internal fixation which determines the fate of the femoral head [19, 20].

Menninger et al [20] proposed that fracture fixation within six hours after the incident is of great importance. In our cases, whether or not the time point of the operation was an important element of the occurrence of avascular necrosis could not be identified, because of poor history and inability to reach from far away peripheral areas.

Researchers also reported that the accuracy of fracture reduction is a very important determining factor of the fracture neck of femur prognoses [21, 22]. According to Nilsson 1989 [23] single most important prognostic factor is the accurate fracture reduction which maximizes blood supply. According to the standard provided by the Garden's alignment index, there should not be an angulation of 20° or more [18]. The reason for angulation is that the posterior cortical bone tends to be crushed when a FNF has occurred, so it makes the anterior angulation. Therefore, degrees of angulation found in imaging examinations conducted during operations were permitted within acceptable range which is possible when tendency of anterior angulation should be reduced further during fracture reduction before fixation. In this study, we always tried to restore trabecular pattern within acceptable range of Garden's alignment index and this was one of the reasons that frequency of AVN was very low i-e 11%.

This study has a few limitations because its simply x-rays based study. It is a simple X-ray based study, so three-dimensional evaluation of fracture neck of femur not possible. Zhou et al [24] reported three-dimensional analysis of fractured femur so, there is a room for application to the fractured neck of femur. The data of the functional outcome was insufficient. Similarly, procedure of operation may be a bit different because the numerous surgeons were involved. Moreover, study population was not very large and the statistical analysis was not powerful. In addition, the anatomical location of the fractures, patients' bone densities and the site of screw placement, which are determinant of fracture instability and prognoses, not evaluated in this study. Therefore, more future studies are needed.

CONCLUSION

We concluded that the AO screw fixation in this type of fracture neck of femur patients younger than 60 years is the procedure of choice. Complications can be minimized when accurate anatomical fracture reduction and fixation achieved.

REFERENCES

1. Merchant RA, Lui KL, Ismail NH, Wong HP, Sitoh Y. The relationship between postoperative complications and outcome after hip fracture surgery. Ann Aced Med Singapore 2005 Mar;34: 163-8.
2. Vertelis A, Petrulis A, Jermolajevas V. Treatment results of displaced femoral neck fractures. Medicine 2002; 38(5): 89-93.
3. Terai T, Henmi T, Kanematsu Y, Fujii K, Sakai T. Clinical evaluation of aged patients who underwent surgery for femoral neck fractures comparative study of clinical results according to age. J Orthop Surg. 2002 Jun;10(1): 23-8.
4. Bucholz RW, Heckman JD. Fractures in adults. 6th ed. Philadelphia: Lippncot Williams & Wilkins, 2005; 1579-1634.
5. Roder F, Schwab M, Aleker T, Morike K, Thon KP, Klotz U. Proximal femur fracture in older patient's rehabilitation and clinical outcome. Age Ageing 2003; 32: 74-80.
6. Solomon L, Warwick D, Nayagam S. Apley's system of orthopaedics' and fractures, 9th ed. London: WB Saunders, 2007; 681-704.
7. Sipila J, Hyvonen P, Partanen J, Ristiniemi J, Jalovaara P. Early revision after hemiarthroplasty and osteosynthesis of cerivical hip fracture. Acta Orthop Scand 2004 Aug;75(4): 402-7.
8. Liporace F, Gaines R, Collinge C, Haidukewych GJ. Results of internal fixation of Pauwels type-3 vertical femoral neck fractures. J Bone Joint Surg Am. 2008 Aug;90(8):1654–1659. doi: 10.2106/JBJS.G.01353.
9. Damany DS, Parker MJ, Chojnowski A. Complications after intracapsular hip fractures in young adults: A meta-analysis of 18 published studies involving 564 fractures. Injury. 2005 Jan;36(1):131–141. doi: 10.1016/j.injury.2004.05.023
10. Nikolopoulos KE, Papadakis SA, Kateros KT, Themistocleous GS, Vlamis JA, Papagelopoulos PJ, et al. Long-term outcome of patients with avascular necrosis, after internal fixation of femoral neck fractures. Injury. 2003 Jul;34(7):525–528. doi: 10.1016/S0020-1383(02)00367-4.
11. Crock HV. An atlas of the arterial supply of the head and neck of the femur in man. Clin Orthop. 1990 Oct;152:17–27.
12. Koval KJ, Zuckerman JD. Hip fractures: I. Overview and evaluation and treatment of femoral-neck fractures. J Am Acad Orthop Surg. 1994 May-Jun;2(3):141–149.
13. Bout CA, Cannegieter DM, Juttmann JW. Percutaneous cannulated screw fixation of femoral neck fractures: the three-point principle. Injury. 1997;28(2):135–139. doi: 10.1016/S0020-1383(96)00161-1.
14. Ly TV, Swiontkowski MF. Treatment of femoral neck fractures in young adults. Instr Course Lect. 2009;58:69–81.
15. Estrada LS, Volgas DA, Stannard JP, Alonso JE. Fixation failure in femoral neck fractures. Clin Orthop Relat Res. 2002;399:110–118.
16. Parker MJ. Prediction of fracture union after internal fixation of intracapsular femoral neck fractures. Injury. 1994;25(2):B3–B6. doi: 10.1016/0020-1383(94)90192-9.
17. Müller ME, Allgower M, Schneider R, Willenegger H. Manual of internal fixation: Techniques recommended by the AO-ASIF Group. 3rd ed. Berlin: Springer-Verlag; 1991. pp. 522–527.
18. Garden RS. Mal-reduction and avascular necrosis in subcapital fractures of the femur. J Bone Joint Surg. 1971 May;53-B:183–197.
19. Jain R, Koo M, Kreder HJ, Schemitsch EH, Davey JR, Mahomed NN. Comparison of early and delayed fixation of subcapital hip fractures in patients sixty years of age or less. J Bone Joint Surg. 2002 Sep;84-A:1605–1612.
20. Manninger J, Kazar G, Fekete G, Fekete K, Frenyo S, Gyarfas F, et al. Significance of urgent (within 6h) internal fixation in the management of fractures of the neck of the femur. Injury. 1989 Mar;20:101–105. doi: 10.1016/0020-1383(89)90152-6.
21. Lu-Yao GL, Keller RB, Littenberg B, Wennberg JE. Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. J Bone Joint Surg. 1994 Jan;76-A:15–25.
22. Alberts KA, Jervaeus J. Factors predisposing to healing complications after internal fixation of femoral neck fracture. A stepwise logistic regression analysis. Clin Orthop Relat Res. 1990 Aug;257:129–133.
23. Nilsson LT, Stromqvist B, Thorngren KG. Secondary arthroplasty for complications of femoral neck fracture. J Bone Joint Surg. 1989 Nov;71-B:777–781.

24. Zhou JJ, Zhao M, Yan YB, Lei W, Lv RF, Zhu ZY, et al. Finite element analysis of a bone healing model: 1-year follow-up after internal fixation surgery for femoral fracture. Pak J Med Sci. 2014 Mar; 30(2): 343–347. doi: 10.12669/ pjms.302.4080.