ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 02 | February - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A PROSPECTIVE INTERVENTIONAL STUDY OF FUNCTIONAL AND RADIOLOGICAL OUTCOME OF BI-PLANE DOUBLE SUPPORTED SCREW FIXATION IN FRACTURE NECK OF FEMUR

Orthopaedics

DR Chaitanya Laxman Kadam* Junior Resident , SMS Hospital Jaipur. *Corresponding Author

DR Shyoji Lal Sharma Senior Professor and Unit Head, SMS Hospital Jaipur

DR Sachin Nayak Junior Resident , SMS Hospital Jaipur

ABSTRACT

INTRODUCTION: The treatment of fracture neck femur varies according to the age of patient, the displacement of fracture fragments and the duration of the fracture. Various treatment options available for patients are cancellous screw fixation, dynamic hip screw, femoral neck system, or arthroplasty in elderly. **MATERIALS AND METHODS:** This is a prospective study done at authors institutes between June 2020- June 2022. 32 patients aged between 18 to 65 years who sustained fracture neck femur were included in the study. 9 were males and 23 were females and they were operated by the biplane double supported screw fixation method (BDSF TECHNIQUE) and were followed up for a period of one years. The final Harris Hip Score at the last follow up was calculated, as well as Radiological union score for hip was calculated. **RESULTS:** Out of the 32 patients, the union was achieved in all the patients. The mean duration of union was 10 weeks. 2 patient had progressive femoral head resorption due to chondrolysis resulting in antalgic gait and unbearable pain and were planned for total hip arthroplasty. The mean harris hip score was 86.8. **CONCLUSION:** In young patients with fracture neck femur osteosynthesis plays an important role and is more efficient that the conventional inverted screw configuration. As well as more affordable than the costlier Femoral neck system. In older patients with osteoporosis and in those patients who can not afford arthroplasty or in those patients where arthroplasty is contraindicated, BDSF method is an alternate method for fixing fracture neck femur.

KEYWORDS

Biplane double supported screw fixation, Osteoporosis, Fracture neck femur, Hemiarthroplasty, Total hip arthroplasty ,Harris Hip Score, Radiological Union Score for hip.

INTRODUCTION

The hip joint forms connection between the lower limb and pelvic girdle.Hip fractures and associated pain is one of the most important causes in disabling the human locomotion.

Hip fractures are common and are about 20% of the operative cases of orthopedicians. The risk of hip fractures is high and lies within range of 40% to 50% in Women and 13% to 22% in men.

Intracapsular femoral neck fractures are common in the old aged after a fall ,femoral neck fractures in young adults are less common. Femoral neck fractures in young patients are usually due to high energy trauma associated with multiple injuries.

Osteosynthesis in femoral neck fracture plays an important role in young population as the head can be saved from complications.

Fracture neck of femur in physiologically young people are associated with high incidences of femoral head avascular necrosis and non union. The incidence of avascular necrosis after fracture neck of femur in physiological young patients is 12% to 86%. This leads to collapse of the femoral head and secondary osteoarthritis of the hip. Arthroplasty surgery are not ideal for the young age and more level of mechanical activity . If patients develops AVN ,he can always undergo THR later on.

While maintaining an anatomic reduction and stable fixation is essential, the effects of other treatment variables like the time to surgery, capsular release, and specific stabilisation techniques also play an important role.

Early accurate anatomical reduction , compression of the fracture , rigid internal fixation are used to promote union but we have less control over the avascular necrosis of femoral head which depends on many factors.

With life expectancy increasing with each decade our society is becoming more and more a geriatric society, with a significant number of hospitalized patients suffering from fracture neck femur. The neck of femur fracture is one of the common fractures in elderly. The prevalence of these fractures has been increasing with increased incidence of osteoporosis, poor vision in elderly, poor neuro muscular coordination, life style changes, sedentary habits, improvement in life expectancy. The incidence is expected to be double in next twenty years, triple by 2050.

Fracture of neck femur is a very common injury in patients more than 50 years of age. According to the present scenario, arthroplasty should be reserved for patients more than 80 years, while in patients age less than 60 sustaining fracture neck femur, joint salvage must be attempted while the ideal treatment of fracture neck femur in the age group 60-80 is still a matter of debate [1].

A number of controversies exist in relation to the cannulated screw fixation for fracture neck femur like number of screws to be used, position of screws in the head and neck and the configuration of screws to be used. A number of biomechanical studies have been done in relation to the ideal screw configuration [2 - 9].

While some authors have suggested central screw placement [10], others have suggested peripheral screw placement [3, 5, 11]. Some authors believe that the screws should be placed parallel to each other [3, 4, 11 - 13], while others believe that screws should be divergent in lateral view [9, 14, 15].

The most commonly used methods by surgeons worldwide to fix fracture neck femur is three parallel screws inserted in inverted triangle configuration [16, 17]. Since the screws are inserted close to each other with entry points near the thin cortex at the base of greater trochanter, they may not be able to withstand anteroposterior bending and varus stresses especially in osteoporotic patients.

To overcome this problem of osteoporosis and for those patients in which arthroplasty is contraindicated, Filipov [18] devised a method of Biplane Double Supported Screw Fixation (BDSF) in which the two screws are laid in two planes, which makes it possible for the entry points of middle and distal screws to be placed in distal solid cortex of proximal diaphysis, the distal screw is placed in the dorsal oblique plane while the middle and proximal screws are inserted in ventral oblique plane. BDSF method uses two calcar buttressed screws: The position achieved by the distal as well as the middle screw, in view of statics, turns them into a simple beam with an overhanging end, loaded with a vertical force. This beam with an overhanging end successfully supports the head fragment, bearing the body weight and transferring it to the diaphysis [19].

MATERIALS AND METHODS

After obtaining proper clearance from the ethical committee, thirty

two patients presenting with fracture neck femur aged between 18-65 years at SMS Medical College, Jaipur institute between June 2020-December 2022 were included in the study.A prospective interventional study was done.

Inclusion criteria: Fracture neck of femur in a person within the age group of 18-65 years, with presentation in period of < 14 days who were ready to give a informed consent and ready for follow up of minimum 6 months.

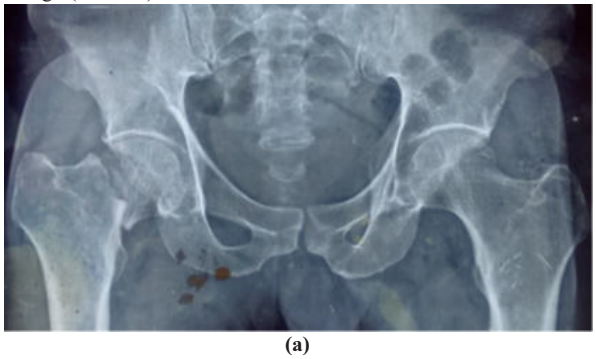
Exclusion Criteria: Patients presenting with pathological fractures, or any major visceral injury. Patients with arthritic changes in the hip were also excluded from the study.All patients will be subjected to full clinical examination, plain radiographs evaluation. 9 patients were male and 23 patient were female (Table 1).

SURGICAL TECHNIQUE

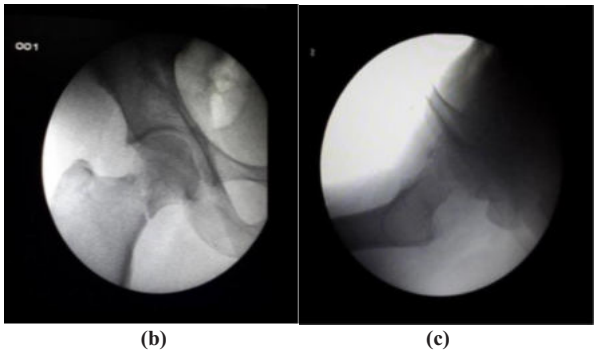
After getting proper consent and pre-anesthetic clearance, the patients are put supine on traction table and reduction is done by Leadbetter technique and C arm images are taken for confirmation before fixation. Only for one fracture open reduction was required done by Watson-Jones approach.

Figs. (**1a**, **b**, **c**).

A straight incision starting at the base of greater trochanter is made with a length of approximately 7-8 cm with BDSF method, three cannulated screws are put in two different planes in the lateral view. The distal screw is placed in the dorsal oblique plane while the middle and proximal screws are placed in the ventral oblique plane as shown in Figs. (**2a** and **b**)

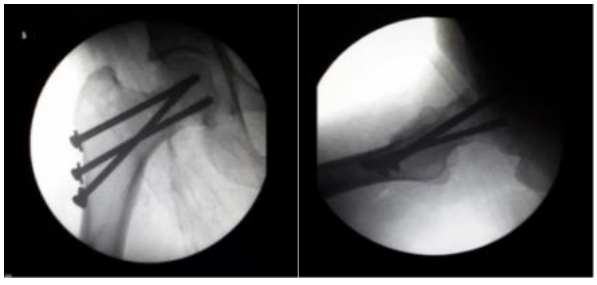


(a)



(b) **(c)**

Fig. (1). A) Showing Fracture Neck Of Femur Right Side. B) Showing Reduction On The Fracture Table In Ap View. C) Showing Reduction In The Lateral View.



a b

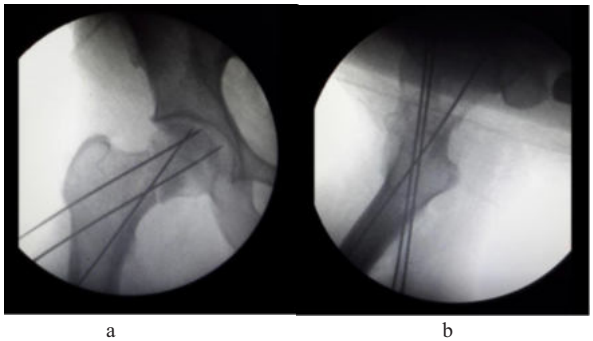
Fig. (2). A) C-arm Picture Showing Position Of Screws In The Ap View Of 62 Yrs Old Male Having Fracture Neck Femur. B) Showing Position Of The Screws In The Lateral View With The Distal Screw Placed In Dorsal Oblique Plane End Proximal And Middle Screws Placed In Ventral Oblique Plane.

The first step is to put guide wire for the distal cannulated screw. Its tip is placed 5-7 cm distally from the base of the greater trochanter in the anterior one-third of the surface of the femoral diaphysis. It is directed proximally at an angle of 150-165o, with inclination from anteriorly–distally to posteriorly–proximally, so that after it touches on the curve of the distal femoral neck cortex, the wire goes into the posterior half of the femoral head as shown in Fig. (**3**).

Fig. (3). Showing Position Of First (distal) Guidewire In The Posterior Half Of Femoral Head.

The middle guide wire is placed next. The entry point is at 2-4 cm proximally from the entry point of the distal wire, in the posterior one-third of femoral shaft. This wire is placed at an angle of 135-140o and inclined from posteriorly distally to anteriorly-proximally, so that after it touches the curve of the distal femoral neck cortex, the wire goes into the anterior one-third of the femoral head in the lateral view and in A-P view, the guidewire rests in distal one third of femoral head.

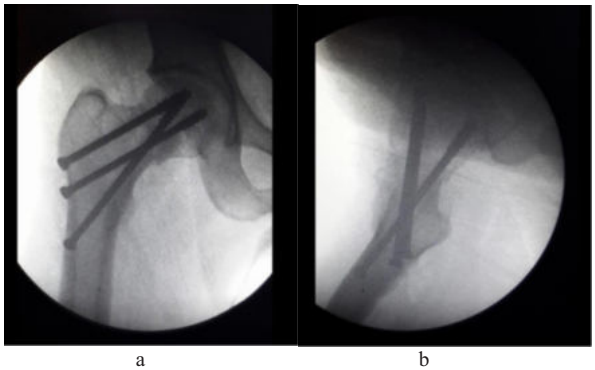
The proximal guidewire is laid in the last. The entry point is 1-2 cm proximally from the entry point of middle wire in the posterior one-third of femoral shaft. It is placed parallel to the middle wire and is directed posterior-distally to anterior proximally so that in the A-P view, the guidewire lies in proximal one-third of femoral head and in the lateral view, it lies in anterior one-third of femoral head as shown in Figs. (**4a** and **b**)



a b

Fig. (4). A) Showing Final Position Of Guidewires In The Ap View Of 76 Yrs Old Female Who Sustained Fracture Neck Femur. B) Showing Final Position Of Guidewires In Lateral View With Distal Guidewire In Dorsal Oblique Plain And Proximal And Middle Guidewires In Ventral Oblique Plain.

Being perpendicular to fracture surface, the middle and proximal screws are placed first followed by insertion of the distal screw as shown in Figs. (**5a** and **b**).



a b

Fig. (5). a) Showing Final Position Of Screws In The Ap View Of The Same Patient As In Fig. 4. **B)** Showing Final Position Of Screws In Lateral View With Distal Screws In Dorsal Oblique Plain And Proximal And Middle Screws In Ventral Oblique Plain.

POSTOPERATIVE PROTOCOL

Postoperative radiographs were obtained on the first postoperative day. The patient was encouraged to do static quadriceps and active assisted/active Straight Leg Raising (SLR) exercises once the patient feels comfortable. The patient was made to sit up on the bedside and toe touch-weightbearing walking was started 24 hours after the surgery.

Patients were discharged from hospital 48 to 72 hours after surgery. All the patients were followed up clinically and radiologically at two weeks, six weeks, three months, six months, twelve months. Patients were evaluated using Modified Harris Hip Score for the functional outcome post operatively. Radiographs in the form of X-rays of pelvis with both hip Antero-posterior and cross table lateral views were obtained to see for progressive signs of union and evaluated for union on basis of Radiological Union Scale for Hip. Radiologically fracture union were defined as continuity of at least three cortices in AP and lateral views without any fracture gap.

Partial weight bearing was allowed after three weeks and full weight bearing was allowed after the radiographic union was evident.

Radiologically fracture union was defined as continuity of at least three cortices in AP and lateral views without any fracture gap. Clinically fracture was considered as healed when there was no local tenderness and patient could do full weightbearing without any support. Stair climbing and hip abductor strengthening exercises were gradually initiated after 6 weeks.

Once the fracture was healed, patients were encouraged to sit on the floor cross-legged and to do squatting as it is an essential part of the routine in Indian population.

RESULTS

Out of the 32 patients, 9 were males (28%) and 23 (71.9%) were females. The average age was 44.3 years. The youngest patients were aged 22 years while eldest being 62 years. Majority of the patients were belonging to the 4th decade i.e. (40-50 year age group) age group details of which were shown in Bar Chart.

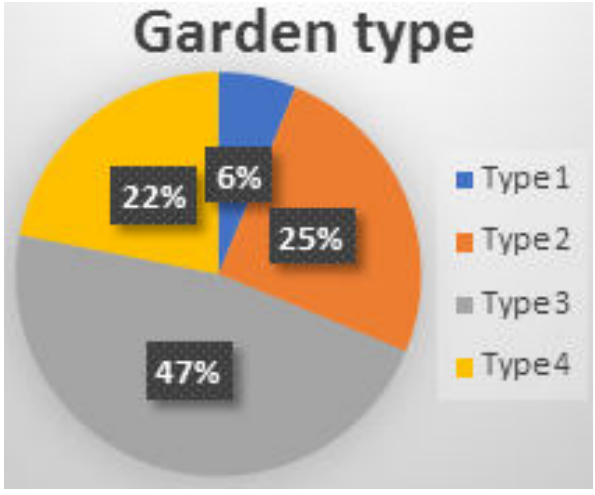
Bar Chart. Showing distribution of patients with fracture neck of femur in different.

Bar Chart. Showing distribution of patients with fracture neck of femur in different

Table (1): Demographic data of the patients.

Variable		The Studied Population (n=20)
Age(years)		
Mean ± SD		44.3±10.89
Median (range)		44(22-62)
Sex	Male	9(28%)
	Female	23 (71.9%)

Out of the 32 patients, 2 6(%) were Garden type 1, 8 (25%) were Garden type 2, 15 (47%) were Garden type 3 and 7(22%) were Garden type 4.



Pie Chart showing Garden classification

The mean HARRIS HIP score was 86.8, with the maximum score being 96 and minimum being 70. Out of the 32 patients, none had poor HHS, 4 (12.5%) had fair HHS, 14 (43.8%) had good HHS, while excellent HHS was seen in 14 (43.8%) patients.

All the fractures united uneventfully as shown in Figs. (**6a** and **b**, **7a** and **b**). The mean duration of union was 10 weeks. Two patient had femoral head resorption due to the chondrolysis and required a total hip arthroplasty. None of the cases had an implant failure.

Table (2): Functional Outcome Of The Studied Patients

	The Studied Population (n=32)
Excellent	14 (43.8%)
Good	14 (43.8%)
Fair	4 (12.5%)
Poor	Nil

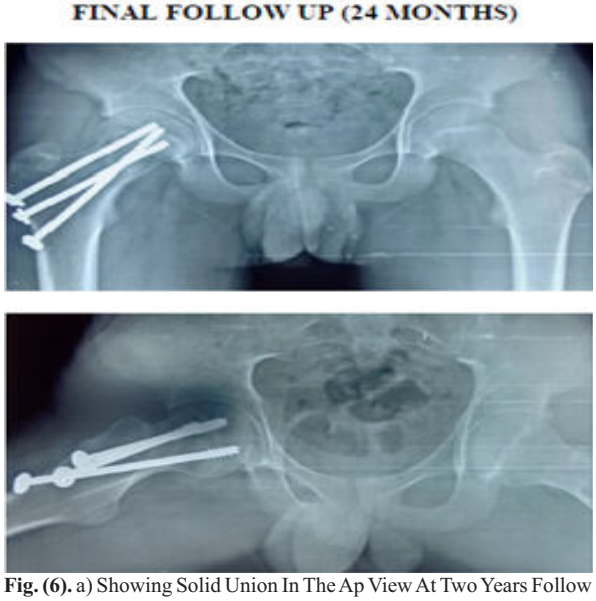


Fig. (6). a) Showing Solid Union In The Ap View At Two Years Follow Up Of The Same Patient As In Fig. **4**. **B)** Showing Solid Union In The Lateral View At Two Years Follow Up.

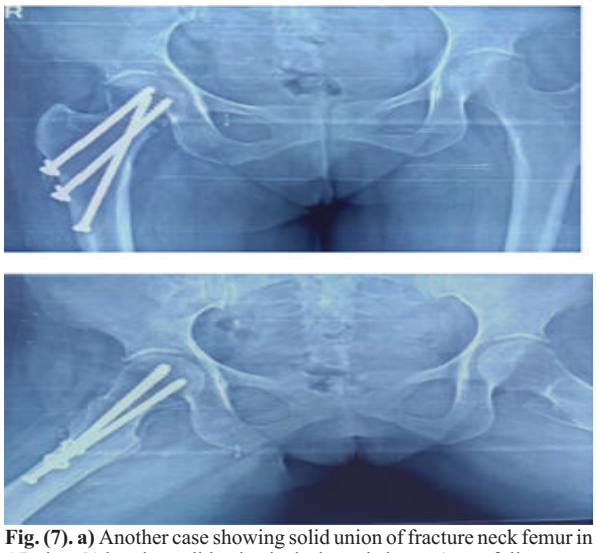


Fig. (7). a) Another case showing solid union of fracture neck femur in AP view. **b)** howing solid union in the lateral view at 1 year followup.

DISCUSSION

There seems to be a lot of controversy regarding the cannulated screw fixation for fracture neck femur like the number of screws to be used, configuration of screws and their position in head and neck. The method most widely practiced by surgeons for fixing the fracture neck femur is by three cancellous screws placed parallel to each other and various authors have reported the failure rate to be as high as 20-42% [20 - 24]. This failure can be accounted for many factors. One of the factors is that the entry point of the screws lies in the thin and fragile cortex of greater trochanter or near to it and such a mechanical construct relies on inter-fragmentary compression achieved intra-operatively for its success but the amount of interfragmentary compression achieved depends on how much solid the cancellous bone is. So this accounts for high failure rate in osteoporosis [18].

Biplane Double Supported Screw Fixation method [18] (BDSF) overcomes these problems and has various unique advantages and the results of our study prove it to be a useful method particularly in relevance to the Indian population.

The position of the distal screw as well as the middle screw achieved by the method, in terms of statics, turns them into a simple beam with an overhanging end, loaded with a vertical force. This beam with an overhanging end successfully supports the head fragment bearing the body weight and transferring it to the diaphysis. Moreover, due to the biplane placement, enough space for a third screw is provided, whereas in the conventional methods for fixing neck femur, only one or a maximum of two screws can be placed at an obtuse angle [25, 26]. Another advantage of the method is that due to the increase in the distance between the two supporting points, the weight borne by the bone is reduced. Since the entry points of the screws are positioned wide apart from each other, which ensures that when weightbearing, the tensile forces are spread over a greater surface of the lateral cortex and thus the risk of its fracturing decreases significantly. Since the distal screw touches the posterior cortex and also being placed at an obtuse angle, it provides improved strength of fixation at the anteroposterior bending of neck (when arising from a chair) and this has been confirmed biomechanically [27].

Since ours is a government tertiary care referral centre, majority of our patients have insurance coverage and ,so these patients can undergo this surgery at our hospital free of cost, BDSF method can be picked as the first choice in the selected age group since the cost of screw fixation is remarkably less as compared to arthroplasty.

Majority of our operated cases came from rural background who require sitting cross-legged and squatting for their daily activities and despite being told not to do such activities, these patients at follow up were found to be very comfortable in doing such activities, while in case of arthroplasty, prolonged supervision is required.

BDSF method has several advantages such as small learning curve, cost-effectiveness, short operative time and it requires normal theatre set up but the only critical point is the perfect positioning of the guide wires which initially may seem difficult but with strict adherence to principles this can be mastered in no time.

The strength of our study is that it is a prospective study with adequate follow up while the weakness is that the sample size is small to comment on the complications. Also for study on avascular necrosis need a study duration for longer time.

CONCLUSION

BDSF method was devised mainly to address that group of patients who have to undergo osteosynthesis or in those who have contraindications for arthroplasty and we have found this as an excellent method in terms of fracture consolidation and functional outcome. This construct provides the solid stability required for endosteal healing of these fractures and we found it very suitable for Indian patients whose daily activities require sitting cross-legged as well as squatting. We, therefore, recommend that this method of fixation.

REFERENCES

[1] Bhandari M, Devereaux PJ, Tornetta P III, *et al.* Operative management of displaced femoral neck fractures in elderly patients. An international survey. J Bone Joint Surg Am 2005; 87(9): 2122-30.[http://dx.doi.org/10.2106/JBJS.E.00535] [PMID: 16140828]

[2] Mizrahi J, Hurlin RS, Taylor JK, Solomon L. Investigation of load transfer and optimum pin configuration in the internal fixation, by Muller screws, of fractured femoral necks. Med Biol Eng Comput 1980; 18(3): 319-25. [http://dx.doi.org/10.1007/BF02443386] [PMID: 7421314]

[3] Swiontkowski MF, Harrington RM, Keller TS, Van Patten PK. Torsion and bending analysis of internal fixation techniques for femoral neck fractures: The role of implant design and bone density. J Orthop Res 1987; 5(3): 433-44. [http://dx.doi.org/10.1002/jor.1100050316] [PMID: 3625366]

[4] Lindequist S, Wredmark T, Eriksson SA, Samnegård E. Screw positions in femoral neck fractures. Comparison of two different screw positions in cadavers. Acta Orthop Scand 1993; 64(1): 67-70.***Biplane Double Supported Screw Fixation The Open Orthopaedics Journal, 2018, Volume 12*** **523** [http://dx.doi.org/10.3109/17453679308994532] [PMID: 8451951]

[5] Booth KC, Donaldson TK, Dai QG. Femoral neck fracture fixation: A biomechanical study of two cannulated screw placement techniques. Orthopedics 1998; 21(11): 1173-6. [PMID: 9845448]

[6] Kauffman JI, Simon JA, Kummer FJ, Pearlman CJ, Zuckerman JD, Koval KJ. Internal fixation of femoral neck fractures with posterior comminution: A biomechanical study. J Orthop Trauma 1999; 13(3): 155-9. [http://dx.doi.org/10.1097/00005131-199903000-00001] [PMID: 10206245]

[7] Walker E, Mukherjee DP, Ogden AL, Sadasivan KK, Albright JA. A biomechanical study of simulated femoral neck fracture fixation by cannulated screws: Effects of placement angle and number of screws. Am J Orthop 2007; 36(12): 680-4 [PMID: 18264547]

[8] Tan V, Wong KL, Born CT, Harten R, DeLong WG Jr. Two-screw femoral neck fracture fixation: A biomechanical analysis of 2 different configurations. Am J Orthop 2007; 36(9): 481-5. [PMID: 17948152]

[9] Lykke N, Lerud PJ, Strømsøe K, Thorngren KG. Fixation of fractures of the femoral neck. A prospective, randomised trial of three Ullevaal hip screws versus two Hansson hook-pins. J Bone Joint Surg Br 2003; 85(3): 426-30.[http://dx.doi.org/10.1302/0301-620X.85B3.13788] [PMID: 12729123]

[10] Rehnberg L, Olerud C. The stability of cervical hip fractures and its influence on healing. J Bone Joint Surg Am 1989; 71-B: 173-7. [http://dx.doi.org/10.1302/0301-620X.71B2.2925729]

[11] Asnis SE. The guided screw system in intracapsular fractures of the hip. Contemp Orthop1985; 10: 33-42.

[12] von Bahr V, Syk B, Walheim G. Osteosynthesis of femoral neck fracture using screws. Acta Chir Scand 1974; 140(4): 277-82. [PMID: 4837808]

[13] Lagerby M, Asplund S, Ringqvist I. Cannulated screws for fixation of femoral neck fractures. No difference between Uppsala screws and Richards screws in a randomized prospective study of 268 cases. Acta Orthop Scand 1998; 69(4): 387-91. [http://dx.doi.org/10.3109/17453679808999052] [PMID: 9798447]

[14] Parker MJ, Tagg CE. Internal fixation of intracapsular fractures. J R Coll Surg Edinb 2002; 47(3): 541-7. [PMID: 12109607]

[15] Gurusamy K, Parker MJ, Rowlands TK. The complications of displaced intracapsular fractures of the hip: The effect of screw positioning and angulation on fracture healing. J Bone Joint Surg Br 2005; 87(5): 632-4. [http://dx.doi.org/10.1302/0301-620X.87B5.15237] [PMID: 15855363]

[16] Patwa J J, Krishnan A, Pamecha CC. Biogeometry of femoral neck for implant placement. Indian J Orthop 2006; 40: 224-7. [http://dx.doi.org/10.4103/0019-5413.34499]

[17] Huang HK, Su YP, Chen CM, Chiu FY, Liu CL. Displaced femoral neck fractures in young adults treated with closed reduction and internal fixation. Orthopedics 2010; 33(12): 873. [PMID: 21162504]

[18] Filipov O. Biplane double-supported screw fixation (F-technique): A method of screw fixation at osteoporotic fractures of the femoral neck Eur J Orthop Surg Traumatol 2011; 21(7): 539-43. [http://dx.doi.org/10.1007/s00590-010-0747-9] [PMID: 21966288]

[19] Filipov O. Biplane double-supported screw fixation (F-technique): A method of screw fixation atosteoporotic fractures of the femoralneck. Eur J Orthop Surg Traumatol 2011 ; 21(7): 539-43.

[20] Asnis SE, Wanek-Sgaglione L. Intracapsular fractures of the femoral neck. Results of cannulated screw fixation. J Bone Joint Surg Am 1994; 76(12): 1793-803. [http://dx.doi.org/10.2106/00004623-199412000-00005] [PMID: 7989384]

[21] Blomfeldt R, Törnkvist H, Ponzer S, Söderqvist A, Tidermark J. Internal fixation versus hemiarthroplasty for displaced fractures of the femoral neck in elderly patients with severe cognitive impairment. J Bone Joint Surg Br 2005; 87(4): 523-9. [http://dx.doi.org/10.1302/0301-620X.87B4.15764] [PMID: 15795204]

[22] Gjertsen JE, Vinje T, Engesaeter LB, *et al.* Internal screw fixation compared with bipolar hemiarthroplasty for treatment of displaced femoral neck fractures in elderly patients. J Bone Joint Surg Am 2010; 92(3): 619-28.[http://dx.doi.org/10.2106/JBJS.H.01750] [PMID: 20194320]

[23] 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 Am 1994; 76(1): 15-25. [http://dx.doi.org/10.2106/00004623-199401000-00003] [PMID: 8288658]
[24] Rogmark C, Johnell O. Primary arthroplasty is better than internal fixation of displaced femoral neck fractures: A meta-analysis of 14 randomized studies with 2,289 patients. Acta Orthop 2006; 77(3): 359-67. [http://dx.doi.org/10.1080/17453670610046262] [PMID: 16819672]
[25] Dickson JA. The unsolved fracture; a protest against defeatism. J Bone Joint Surg Am 1953; 35-A(4): 805-22. [http://dx.doi.org/10.2106/00004623-195335040-00001] [PMID: 13108884].
[26] Garden RS. Low-angle fixation in fractures of the femoral neck. J Bone Joint Surg Br 1961; 43-B(4): 647-63. [http://dx.doi.org/10.1302/0301-620X.43B4.647]
[27] Walker E, Mukherjee DP, Ogden AL, Sadasivan K K, Albright JA. A biomechanical study of simulated femoral neck fracture fixation by cannulated screws: Effects of placement angle and number of screws. Am J Orthop 2007; 36(12): 680-4. [PMID: 18264547]