

Medial Femoral Neck Fractures in Young Adults: Our Experience at Two Years Follow-up

Luca Gurrieri, Gianluca Testa, Pietro Maniscalco, Calogero Puma Pagliarello, Marco Andolfi, Salvatore D'Amato, Gianluca Puglisi, Danilo Di Via, Corrado Ciatti, Vito Pavone

Department of General Surgery and Medical Surgical Specialties, Section of Orthopaedics and Traumatology, AOU Policlinico-Vittorio Emanuele, University of Catania, 95123, Catania, Italy

ABSTRACT

Intracapsular femoral neck fractures in young adults are injury with great social relevance. Garden I-II fractures must be treated urgently by reduction and osteosynthesis with cannulated screws, to exploit the biological response of the bone, avoiding a joint replacement. The aim of our study is to analyze the results of this treatment, the complications, identify factors that condition the success and compare our results with the relevant literature. At our institutes, 26 young adults with medial femoral neck fractures were surgically treated within 6 h with reduction and fixation with cannulated screws. 11 (42.3%) were males and 15 (57.7%) females; 25 had no comorbidities at the time of surgery. Left side was fractured in 11 cases (42.3%) and right was fractured in 15 (57.7%). According Garden classification, 8 (30.8%) fractures were type I, 18 (69.2%) type II. Mean age at treatment was 53.57 ± 3.25 (range 45–58) years. At 2 years follow-up three patients have undergone a joint replacement, due to the occurrence of necrosis of the femoral head (avoid avascular necrosis [AVN]); one patient suffering by non-union complication rate of 15.4% (AVN 11.5% and non-union 3.9%). Student's *t*-test did not show a statistically correlation between complications and fracture typology ($P > 0.05$). Reduction and osteosynthesis with cannulated screws, performed in urgency (<6 h) is a valid alternative regardless of age, with excellent results in medium-term follow-up, in non-displacement fractures.

Key words: Avascular necrosis, cannulated screw, complications, femoral neck fractures, timing of surgery

INTRODUCTION

Femoral neck fractures are common injury, accounting for approximately 11.6% of adult fractures, with a prevalence in women compared to men, according to the higher incidence of osteoporosis in women rather than men, with an F: M ratio of 2.5:1.^[1] The incidence of femoral neck fractures increases exponentially with advanced age.

The annual worldwide incidence of femoral neck fracture is estimated in 1.6 million cases and is continuously growing due to the increase in the average age of the population.^[2] The main causes of these fracture are represented by low energy

traumas, in osteoporotic subjects, and high energy trauma, in young people. Intracapsular femoral neck fractures were commonly classified according Garden, in undisplaced incomplete, including valgus impacted fractures (type I); undisplaced complete (type II); complete and partially displaced fracture (type III); and complete and displaced fracture (type IV).^[3]

In the young adult, the main objective is to avoid avascular necrosis (AVN) of femoral head and non-union, because joint replacement is not ideal, given the high functional demand. Anatomical reduction and stable fixation are essential for a successful outcome. Internal fixation with cannulated screws

Address for correspondence:

Luca Gurrieri, Department of General Surgery and Medical Surgical Specialties, Section of Orthopaedics and Traumatology, AOU Policlinico-Vittorio Emanuele, University of Catania, 95123, Catania, Italy.

DOI: 10.33309/2639-8885.040101

© 2021 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

is used for Garden I-II, ORIF techniques with Dynamic Hip Screw is usually used for Garden III-IV.^[4] Timing of surgery remains controversial;^[5,6] however, many authors support urgent surgical treatment.^[7-9]

The aim of the present study is to report the outcomes of adults with medial femoral neck fractures surgically treated within 6 h with closed reduction and fixation with three cannulated screws, evaluating the complications and identify factors that condition the success and compare our results with the relevant literature.

PATIENTS AND METHODS

Selection criteria

Between January 2018 and December 2018, at our institutes, a sample of 26 young adults with medial femoral neck fractures were surgically treated with closed reduction and fixation with cannulated screws. Inclusion criteria were: Age at the time of surgery between 40 and 59 years; Garden's Classification types I-II; minimally invasive surgical treatment of reduction and fixation with three cannulated screws; and surgical intervention time <6 h from trauma patients with age ≥ 60 years.

Garden types III and IV fractures, time of surgery more than 6 h from trauma were ruled out from the study.

Demographic data

Of a total of 26 selected patients, 11 (42.3%) were males and 15 (57.7%) females; 25 had no comorbidities at the time of surgery. Left side was fractured in 11 cases (42.3%), right in 15 (57.7%). According Garden classification, 8 (30.8%) fractures were type I, 18 (69.2%) type II. Mean age at treatment was 53.57 ± 3.25 (range 45–58) years.

Surgical technique

Medial femoral neck fractures in young adults and in cases classified as Garden types I and II must be treated in the first instance by reduction and osteosynthesis with the use of cannulated cancellous bone screws.^[10] The rationale lies in the fact that in young patients there may be a sufficient biological response to heal the fracture, maintaining the structural integrity of the bone and thus avoiding a prosthetic replacement.^[11]

Reduction and fixation by cannulated screws were performed with the patient positioned on the orthopedic traction bed. Under the radioscopic guide, a small 3–4 cm incision was made at the projection point of the skin of the greater trochanter. Once the lata fascia was incised, the bone plane was reached.

Pilot holes are drilled using a 4–5 mm diameter bit. The cannulated screws with 6.5 mm diameter were placed as parallel as possible to each other and according to an inverted equilateral triangle model.^[12]

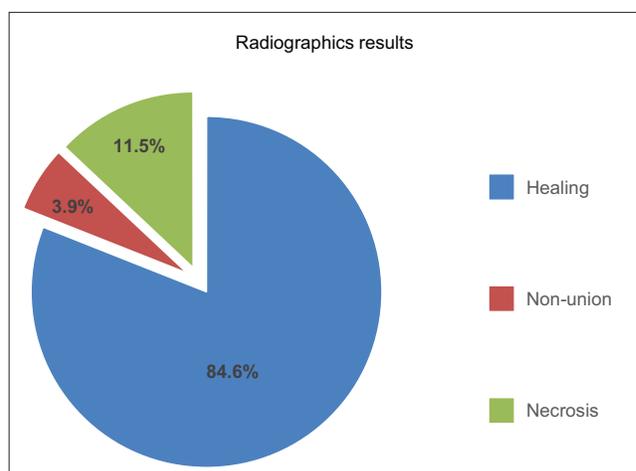


Figure 1: Radiographic evaluation at follow-up

Post-operative treatment has scheduled antibiotic prophylaxis for 1 days and antithromboembolic prophylaxis up to the grant of the total load. Physical rehabilitation started the day after surgery. A partial load was initially granted with crutches, according to Pauwels classification. Full load was granted 8 weeks after surgery.

Clinical and radiographic assessment

Clinical and radiological follow-up was performed at 1-2-3-6-12 and 24 months.

Radiographic evaluation was performed using standard radiographic techniques, anteroposterior, and lateral hip radiographs.

Radiographically, loss of reduction or the perceptible fracture line after 6–9 months has been described as non-union. Avascular necrosis of the femoral head was assessed according to Ficat criteria.

Clinical evaluation was performed by Harris Hip score (HHS). HHS is an outcome measure designed by Harris in 1969 to provide a standardized criterion for assessing the functionality of hip joint. The maximum score possible is 100. Results can be interpreted with the following: <70 = poor result; 70–80 = fair, 80–90 = good, and 90–100 = excellent.

Statistical analysis

To assess the statistical significance of the results, we referred to the Student's *t*-test, which allows to check if the average value of a distribution deviates significantly from a reference value.

RESULTS

Of the 26 patients undergoing to surgery:

- Twenty-four are in excellent health and carry out normal activities again, however, two have undergone, after a

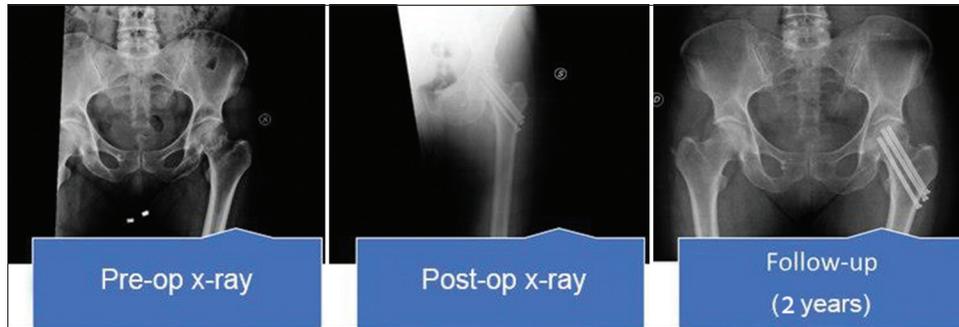


Figure 2: First clinical case, T.B. female, 52 years old, healing outcome

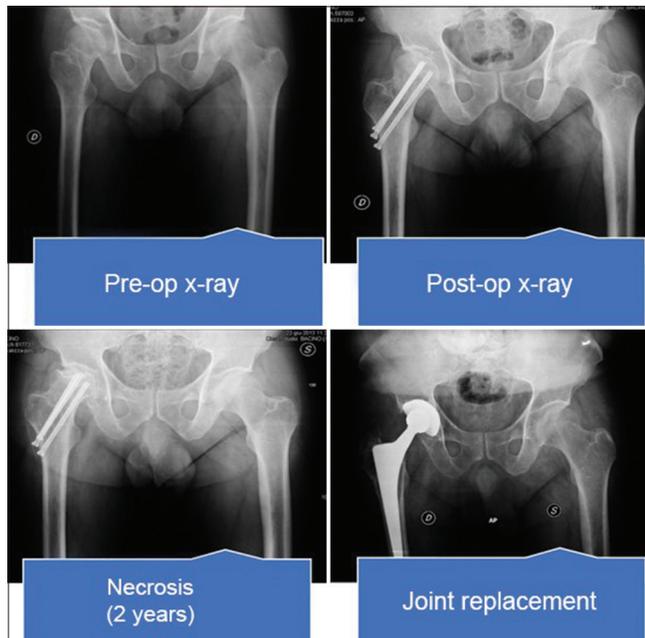


Figure 3: Second clinical case, V.R. male, 57 years old, avascular necrosis

period of relative well-being, prosthetic replacement, about 18 months after the fracture, due to the occurrence of necrosis of the femoral head

- One patient suffering by non-union
- One patient suffering by spastic quadriplegia (diagnosed before surgery).

The HHS results were:

- Excellent in 24 cases (92.3%)
- Poor in two cases (7.7%), one patient with spastic quadriplegia and one patient with non-union, who refused joint replacement.

To the radiographic evaluation:[Figure 1]

- Twenty-two patients healing (84.6%) [Figure 2]
- One shows signs of non-union (3.9%)
- Three prosthesis replacement after necrosis (11.5%) [Figure 3].

Therefore, considering a sample of 26 patients, there is a cure rate of around 84.6% and a remaining complication rate of 15.4%, of which 11.5% is represented by necrosis of the femoral head and 3.9% from non-union.

Complications involved one patient with Garden I fracture and two patients with Garden II fractures.

Specifically, non-union in patient with Garden I fracture, and first case of AVN in Garden I fracture and second one in Garden II fracture.

Student's *t*-test did not show a statistically valid correlation between complications and fracture typology ($P > 0.05$).

DISCUSSION

Medial femoral neck fractures in young adult (<60 years old) represent an important problem, both from a purely individual point of view and from a social point of view. Today, in fact, the patient under 60 is still in the full swing of his work: Therefore, the impact on the health system and, in general, the socio-economic implications are not indifferent.

This injury, in this particular category of patients, is most often the result of high energy trauma. When the fracture is not associated by further injuries that put the patient at risk of life, it is treated in an urgency regime (<6 h).^[7] The surgical treatment of reduction and osteosynthesis with cannulated screws, performed in urgency is a valid alternative regardless of age, with excellent results in medium-term follow-up, in Garden I-II. The results of our study confirm its effectiveness. However, our study does not have a delayed treated control sample; this is a limitation to search for statistically valid data.

We did not observe statistical correlation between complications and fracture type, but our sample was very small and made up only of non-displaced fractures.

According to some authors, the prognosis will be better in Garden I-II because non-displaced fractures, regardless of urgent treatment,^[13] provided that this is not excessively delayed.^[14]

In scientific literature, however, there are also studies in which the indication for the use of cannulated screws in medial femoral neck fractures goes beyond the Garden stages I-II. Kang *et al.* observed an increase in the complications of AVN, passing from 11% of Garden I-II at 20% of Garden III-IV,^[15] showing a correlation between complications and degree of displacement, already shown by Kim *et al.*^[16]

Wongwai *et al.* stress the osteosynthesis with cannulated screws in Garden III-IV fractures appears, however, more indicated in younger patients, as the percentage of AVN is directly related to the average age of the sample, with a cutoff that settles around 50 years.^[17,18] This is related to anatomy and vascularization of the femoral head, which in patients under 50 is given not only by the branches of the posterior circumflex artery but also by the artery of the round ligament.^[19]

Other complications about intracapsular femoral neck fractures are non-union and intra-articular penetration of the screws. Non-union represents one of the most common complications of femoral neck fractures, in particular of the displaced ones. The pathogenesis is due to the fact that the fracture does not have the necessary conditions for optimal healing.

The intra-articular penetration of the screws represents a possible complication that occurs in a small percentage of patients. The risk is greater in valgus meshed fractures (Garden type I) than in other types of fractures. Moroni *et al.*^[20] have shown that screws with hydroxyapatite coating have a greater mechanical seal in the interface with the bone than standard screws, which results in a lower shortening of the neck and a lower incidence of screw penetration inside the articulation.

REFERENCES

- Guzon-Illescas Q, Fernandez EP, Villarias NC, Donate FJ, Peña M, Alonso-Blas C, *et al.* Mortality after osteoporotic hip fractures: incidence, trends and associated factors. *J Orthop Surg Res* 2019;14:203.
- Veronese N, Maggi S. Epidemiology and social costs of hip fractures. *Injury* 2018;49:1458-60.
- Kazley JM, Banerjee S, Abousayed MM, Rosenbaum AJ. Classifications in brief: Garden classification of femoral neck fractures. *Clin Orthop Relat* 2018;476:441-5.
- Schwartzmann CR, Jacobus LS, de Freitas Spinelli L, Boschin LC, Gonçalves RZ, Yépez AK, *et al.* Dynamic hip screw for the treatment of femoral neck fractures: A prospective study with 96 patients. *ISRN Orthop* 2014;2014:257871.
- Gumustas S, Tosun HB, Isyar M, Serbest S, Oznam K, Bulut G. Femoral neck fracture in young adults, is it really an urgent surgery indication: retrospective clinical study. *Pan Afr Med J* 2018;30:112.
- Razik F, Alexopoulos AS, El-Osta B, Connolly MJ, Brown A, Hassan S, *et al.* Time to internal fixation of femoral neck fractures in patients under sixty years--does this matter in the development of osteonecrosis of femoral head? *Int Orthop* 2012;36:2127-32.
- Papakostidis C, Panagiotopoulos A, Piccioli A, Giannoudis PV. Timing of internal fixation of femoral neck fractures. A systematic review and meta-analysis of the final outcome. *Injury* 2015;46:459-66.
- 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* 2002;84:1605-12.
- Kazley J, Bagchi K. *Femoral Neck Fractures*. Treasure Island, FL: StatPearls Publishing; 2020.
- Karaeminogullari O, Demirors H, Atabek M, Tuncay C, Tandogan R, Ozalay M. Avascular necrosis and nonunion after osteosynthesis of femoral neck fractures: Effect of fracture displacement and time to surgery. *Adv Ther* 2004;21:335-42.
- Bishop JA, Behn AW, Castillo TN. The biomechanical significance of washer use with screw fixation. *J Orthop Trauma* 2014;28:114-7.
- Selvan TC, Oakley MJ, Rangan A, Al-Lami MK. Optimum configuration of cannulated hip screws for the fixation of intracapsular hip fractures: A biomechanical study. *Injury* 2004;35:136-41.
- Chan DS. Femoral neck fractures in young patients: State of the art. *J Orthop Trauma* 2019;33 Suppl 1:S7-S11.
- Crist BD, Eastman J, Lee MA, Ferguson TA, Finkemeier CG. Femoral neck fractures in young patients. *Instr Course Lect* 2018;67:37-49.
- Kang JS, Moon KH, Shin JS, Shin EH, Ahn CH, Choi GH. Clinical results of internal fixation of subcapital femoral neck fractures. *Clin Orthop Surg* 2016;8:146-52.
- Kim JY, Kong GM, Park DH, Kim DY. Multiple cannulated screw fixation of young femoral neck fractures. *Park J Med Sci* 2015;31:1517-20.
- Wongwai T, Wajanavisit W, Woratanarat P. Non-Union and avascular necrosis of delayed reduction and screw fixation in displaced femoral neck fracture in young adults. *J Med Assoc Thai* 2012;95 Suppl 10:S120-7.
- Barney J, Piuze NS, Akhondi H. *Femoral Head Avascular Necrosis*. Treasure Island, FL: StatPearls; 2019.
- Crock HV. An atlas of the arterial supply of the head and neck of the femur in man. *Clin Orthop* 1980;152:17-21.
- Gurrieri, Testa, Maniscalco, Andolfi, D'Amato, Di Via. Surgical Treatment of Medial Femoral Neck Fractures Garden Type I-II with a Coated Percutaneous Screws. *Clinical Randomized Study GIOT*; 2005.

How to cite this article: Gurrieri L, Testa G, Maniscalco P, Pagliarello CP, Andolfi M, D'Amato S, Puglisi G, Via DD, Ciatti C, Pavone V. Medial Femoral Neck Fractures in Young Adults: Our Experience at Two Years Follow-up. *Clin Res Orthop* 2021;4(1):1-4. DOI: 10.33309/2639-8885.040101