MOST COMMON POSTOPERATIVE COMPLICATIONS IN THE FEMORAL NECK FRACTURES IN YOUNG POPULATION

Article · December 2020

CITATIONS
0

READS
98

9 authors, including:

Aleksandar Savevski
University American College Skopje
25 PUBLICATIONS **8** CITATIONS
SEE PROFILE

Aleksandar Trajanovski
TOARILUC
16 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Antonio Gavrilovski
15 PUBLICATIONS **10** CITATIONS
SEE PROFILE

Daniela Georgieva
Ss. Cyril and Methodius University in Skopje
30 PUBLICATIONS **18** CITATIONS
SEE PROFILE

UDK :61

ISSN 1857-5587

PHYSIOACTA

Journal of Macedonian Association of Physiologists and Anthropologists

Vol 14 No 2
2020

UDK: 616.718.4-001.5-089.168-06

MOST COMMON POSTOPERATIVE COMPLICATIONS IN THE FEMORAL NECK FRACTURESIN YOUNG POPULATION

Saveski A[1,2], Trajanovski A[1], Gavrilovski A[1], Georgieva D[1,2]Foteva M[1,2], Atanasov N[1,2], Kamnar V [1,2], Nikolov L[2,3], Hasani I [2,3]

1. University Clinic for Orthopaedic surgery, Skopje, Republic of North Macedonia
2. Faculty of Medicine "St. Cyril and Methodius" University in SkopjeRepublic of North Macedonia
3. University Clinic for Traumatology, Skopje, Republic of North Macedonia

Abstract

Introduction. Intracapsular femoral neck fractures in the young population pose a serious problem in their definitive surgical treatment. Nondisplaced fractures (Garden I and II) almost always heal well, with a good finalresult and outcome. Unlike nondisplaced, displaced fractures (Garden III and IV) are usually burdened with postoperative complications such as: avascular necrosis of the femoral head, nonunion (pseudoarthrosis), and fixation failure (osteosynthesis failure). Such complications significantly change the quality of life, reduce life independence, and increase dependence on another person.

Aim. To measure the quality of life in patients with postoperative complications and to answer which is the most common cause of such complications (avascular necrosis, nonunion and osteosynthesis failure) and how they can be avoided.

Material and methods. A total of 28 patients with postoperative complications after femoral neck fracture with displaced fractures (Garden III and IV) were retrospectively analyzed and surgically treated at the Orthopaedics and Traumatology Clinic. Of the total number, 11 patients had avascular necrosis of the femoral head, and the remaining 17 cases had pseudoarthrosis (nonunion), damaged fixation structure, and osteosynthesis failure (varus head position and "cut out").

Results. In all 28 patients (pseudoarthrosis 17) and (avascular necrosis 11) showed initial poor PCS 36.2 and slightly better in 11 patients with AVN PCS 42+-2.6 first day after admission. In the control examinations of patients with pseudoarthrosis we obtain the following result at 6 weeks PCS showed significant improvement PCS 48+-4.6, and then gradually improved at 3 months 50+-4.6, at 6 months 53+-5.2 and at 12 months 54+-6.2. The mental score remained stable without variations MCS 40.2+-8.6, after 6 weeks MCS 52+-7.2, at 3 months 54+-2.4, at 6 monthsv59+-2.4 and at 12 month 61+-2.5. Patients with AVN of the femoral head showed the following results od PCS at 6 weeks 45.2+-2.9, at 3 months 46.7+-2.1, at 6 months 59.7+-2.7 and at 12 months 61.2+-3.1, while a MCS showedthe following results: at 6 weeks 46+-1.7, at 3 months 47.2+-2.5 at 6 ,omths 60.2+-3.1 and at 12 months 62.5+-2.7

Conclusion. The main risk factors for postoperative complications (pseudoarthrosis and avascular necrosis) are: achieved reduction, time of surgery, presence of dorsomedial communication and screw position.

Keywords: SF-36 score, osteosynthesis, pseudoarthrosis, avascular necrosis.

НАЈЧЕСТИ ПОСТОПЕРАТИВНИ КОМПЛИКАЦИИ КАЈ ДИСЛОЦИРАНИТЕ СКРШЕНИЦИ НА ВРАТОТ НА БУТНАТА КОСКА КАЈ МЛАДАТА ПОПУЛАЦИЈА

Апстракт

Вовед.Интракпсуларните фрактури на вратот на бутната коска кај младата популација битно го менуваат квалитетот на животот и претставува тежок проблем во нивниот дефинитивен хируршки третман .Недислоцираните фрактури (Garden I и II) скоро секогаш добро зараснуваат, со добар краен исход и резултат. За разлика од недислоцираните, дислоцираните скршеници (Garden III и IV) обично се оптоварени со постоперативни компликации како што се: аваскуларната некроза на главата на бутната коска, незараснувањето (псеудоартроза) и „fixation failure'' (попуштање на остеосинтетскиот материјал). Ваквите компликации битно го менуваат квалитетот на животот, ја намалуваат животната независност и ја зголемуваат зависноста од друго лице.

Цел. на оваа ретроспективна студија е да се процени квалитетот на живот на пациентите со постоперативни компликации (хируршки третирани со остеосинтеза) и да сепронајдат причините за ризик факторите кои довеле до настанатите компликации.

Материјал и методи.Од јуни 2015 до јуни 2019 година ретроспективно се анализирани и хируршки третирани на ортопедско-трауматолошкото клиника вкупно 28 пациенти со постоперативни компликации после скршеница на вратот на бутната коска третирани со остеосинтеза (штрафови). Од вкупниот број 11 пациенти беа со аваскуларна некроза на главата на бутната коска, а останатите 17 случаеви со псеудоартроза (незараснување), оштетување на фиксационата конструкција и попуштање на остеосинтезата , варус позиција на главата и „cut out''

Резултати .Кај сите 28 пациенти (псеудоартроза 17) и (аваскуларна некроза на главата на бутната коска11) покажаапочетни лоши резултати на физичко здравје PCS 36.2+- 4.6 кај 17 пациенти со псеудоартроза и нешто подобри кај 11 пациенти со АВН PCS-42+-2.6 првио ден на приемот. На контролните прегледи пациенти со псеудоартроза ги добивме следниве резултати и тоа на 6 недели PCS покажаа знатно подобрување PCS- 48+-4.6, а потоа постепено подобрување на 3 месеци PCS-50+-4.6, на 6 месеци 53+-5.2 и на 12 месеци 54+-6.2.

Од друга страна менталното здравје остана стабилно без варијациипочетно MCS 40.2+-8.6, по 6 недели MCS 52+-7.2, на 3 месеци 54+-2.4, на 6 месеци 59+-2.4 , а веќе на 12 месеци се покачи на 61+-2.5

Пациентите со асептична некроза на главата на бутната коска ги покажаа следниве резултати на физичко здравје (PCS) на 6 недели 45.2+-2.9, на 3 месеци 46.7+-2.1, на 6 месеци 59.7+-2.7 и на 12 месеци 61.2+-3.1, додека резултатитен на менталното здравје ги покажа следниве резултати и тоа: на 6 недели 46+-1.7, на 3 месеци 47.2+-2.5, на 6 месеци 60.2+-3.1 и на 12 месец 62.5+-2.7.

Заклучок:Главните ризични фактори за настанување на постоперативните компликации (псеудоартроза и аваскуларна некроза) во ретроспективната студија се: постигнатата репозиција,време на операција, присуството на дорзомедијална коминуција и позицијата на штрафовите.

Клучни зборови : SF-36 скор, остеосинтеза, псеудоартроза, аваскуларна некроза.

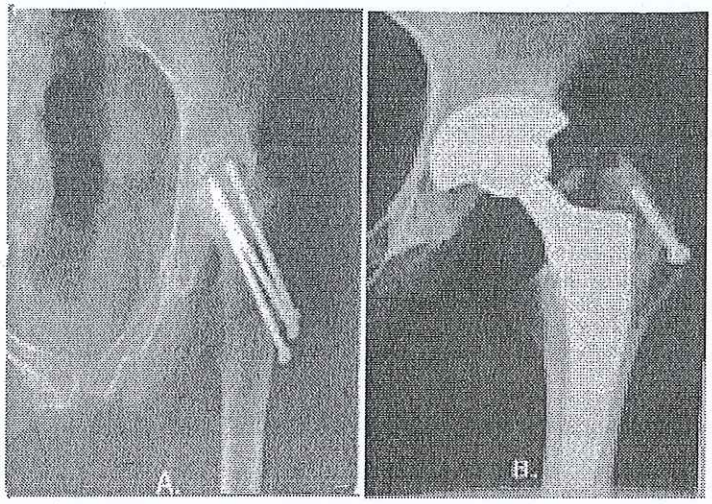
Introdaction

Intracapsular femoral neck fractures in the young population pose a serious problem in their definitive surgical treatment. Nondisplaced fractures (Garden I and II) almost always heal well, with a good final result and outcome. Unlike nondisplaced, displaced fractures (Garden III and IV) are usually burdened with postoperative complications such as: avascular necrosis of the femoral head, nonunion (pseudoarthrosis), and fixation failure (osteosynthesis failure). Such complications significantly change the quality of life, reduce life independence, and increase dependence on another person. Peoplebecome dependent to perform their daily life activities and to accomplish their needs.Today, there is a general consensus everywhere in the world that these fractures should be treated surgically with anatomic repositioning and internal fixation, most often with cannulated screws, and less often with other implants (1, 2, 3, 4, 5, 6).
Multiple studies suggest that early anatomic repositioning and internal fixation of these fractures are an imperative and standard treatment choice for good results (2, 4, 6). On the other hand, regardingthe young population there is still a great deal of controversy and debate over the type of repositioning (closed or open), the type of implants, the position of the screws (parallel or divergent),or the choice of endoprosthesis (fully cemented or uncemented) (7, 5, 8, 9, 10, 11, 6).
Analyzing the risk factors which lead to postoperative complications, we conducted a retrospective study, seeking for the answer which is the most common cause of such complications (avascular necrosis, nonunion and osteosynthesis failure) and how they can be avoided.

Material and methods

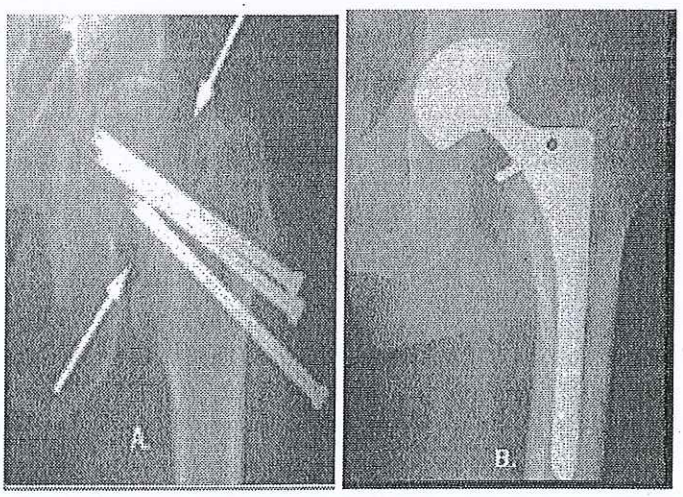
From June 2015 to June 2017, a total of 28 patients with postoperative complications after femoral neck fracture with displaced fractures (Garden III and IV) were retrospectively analyzed and surgically treated at the Orthopaedics and Traumatology Clinic within the TOARILUC (Clinic for Traumatology,OrthopedicDiseases, Anesthesia, Reanimation, Intensive Care and Emergency Centre). Of the total number, 11 patients had avascular necrosis of the femoral head, and the remaining 17 cases had pseudoarthrosis (nonunion), damaged fixation structure, and osteosynthesis failure (varus head position and "cut out").
All patientswere aged 40 to 65. All patients primarily underwent closed repositioning and internal fixation due to a displaced femoral neck fracture (Garden III and IV). Of the total number, 18 were men and 10 were women. Singh's index for osteoporosis was 4-6. The primary surgerydue to afracture was performed in a time interval of 5 to 20 days. Patients' medical documentation from the hospitals where they had previously been operated was used. The results of the follow-up examinations, the reports from the clinical finding, the X-ray as well as other documentation (CT and MRI) and laboratory examinations were broughtby the patients and were used for analysis.
In all patients, the quality of life was determined (measured) with the SF-36 score on the day of admission, and then at each follow-up examination as follows: the first 6 weeks after surgery, after 3, 6 and 12 months. The questionnaires were filled in at each subsequent examination. Finally, statistical data processing was performed for each patient.

Pseudoarthrosis - nonuion was defined when the patient had clinical signs of hip pain and at X-ray there was presence of sclerosis of the fractured edges, impaired position of the screws, with presence of varus deformity and implant migration (screws).
Avascular necrosis was defined when there was presence of: subchondral sclerosis, segmental collapse of the femoral head with loss of its sphericalityor cysts in the femoral head Picture (1).



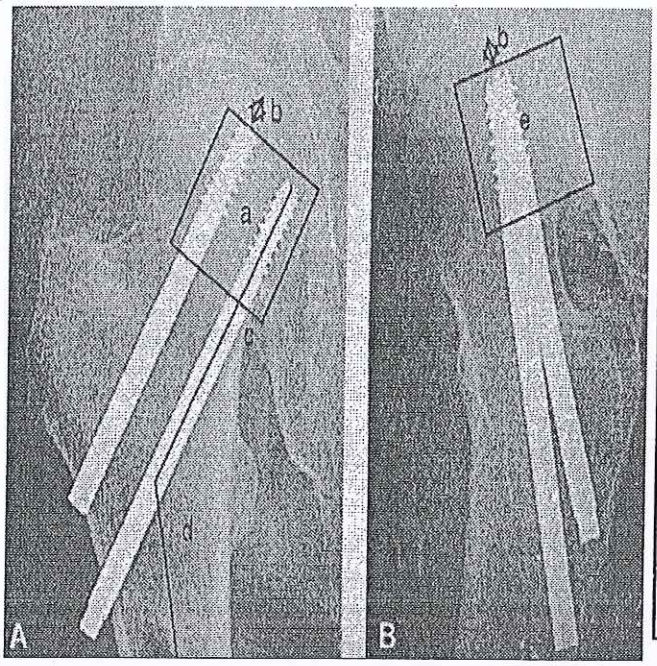
Picture 1 Avascular necrosis and collapse of the femoral head and loosening of osteosynthetic material : A. After fixation with three cannulated screws; B. Conversion to a total endoprosthesis

The position of the screws was evaluated in both planes (AP and profile) immediately after the first intervention. Their position was evaluated according to the criteria of Upadhay *et al.* (6). An improper (inadequate) position was considered if the screws intersected at an angle greater than 10 degrees or if they were convergent with each other at an angle greater than 10 degrees. If the position was parallel to each other or at an angle of less than 10 degrees between them, it was considered proper.If the screw was placed at an angle of less than 130 degrees to the femoral axis, it was considered inadequate.If there were fragments in the posterior-medial part of the femoral neck, then it wasconsidered a posterior comminution (multifagemental).



Picture 2 A. Occurrence of pseudoarthrosis (presence of a fracture line 14 months after surgery, white arrows)B. Implanted total endoprosthesis

Repositioning was assessed according to the Garden Aligment Index (12, 13), the criteria of Lagerby, Asplund, Ringvist (14). Varus position less than 160 degrees on AP projection and posteriorangulation more than 5 degrees on lateral projection (profile) was considered unsatisfactory.
Repositioning was categorized into 3 categories byGarden, as follows: (12)
I. Grade I - Reposition good in both planes (AP and profile) posterior angulation <10 °
II. Grade II - Reposition good in one plane (APor profile) posterior angulation <20 °
III. Grade III - Reposition unsatisfactory in both planes, posterior angulation> 20 °
The position of the screws was estimated according to the modified version bySchlap (previously described in the text) (17). He has described his criteria by giving points for the position of the individual screws, as follows:



a. The position of the screw should be central or caudal on the anterior-posterior projection

b. The distance between the tip of the screw and the articular surface should be up to 10 mm

c. The position of the lowest screw should be directly through the calcar of the AP projection

d. The angle of the screws with the diaphysis of the femur should not exceed 130 degrees

Picture 3 A) Anterior-posterior B) Profile projection

If the total score was 4 points (maximum), then the position of the implants was assessed as an adequate position. Below this, score repositioning was considered inadequate (Picture 3).
All patients were operated under the same conditions, with spinal anesthesia, on an ordinary chair in a supine position. An anterolateral approach by Watson-Johneswas used. The osteosynthetic material was first removed and then the endoprosthesis was implanted. In 21 patients, a non-cement endoprosthesis was implanted and in the remaining 7 patients, a cement endoprosthesis was implanted due to damage to the acetabulum by osteosynthetic material and initial osteoporosis.
Postoperatively, 5–7 days of antibiotic therapy and 6 weeks of postoperative anticoagulant therapy were indicated in all patients. The sutures were removed after 10-14 days. The first postoperative day started with physical therapy with a physiotherapist

and passive movements in bed, and verticalization followed after the control X-ray and removal of the drain.

Results

Of the total number of 28 patients with postoperative complications, 11 patients had avascular necrosis and 17 pseudoarthrosis.

In the group of patients with **pseudoarthrosis**, in terms of the repositioning degree, only 2 patients (12%) achieved reposition grade I, 8 patients achieved reposition grade II, and the remaining 7 patients achieved reposition grade III. So, the achieved reposition in only 2 patients was grade I, and in the other patients grade II and III, which points out to the fact that the main reason for the occurrence of pseudoarthrosis was incorrect reposition in 88% (Figure 1).

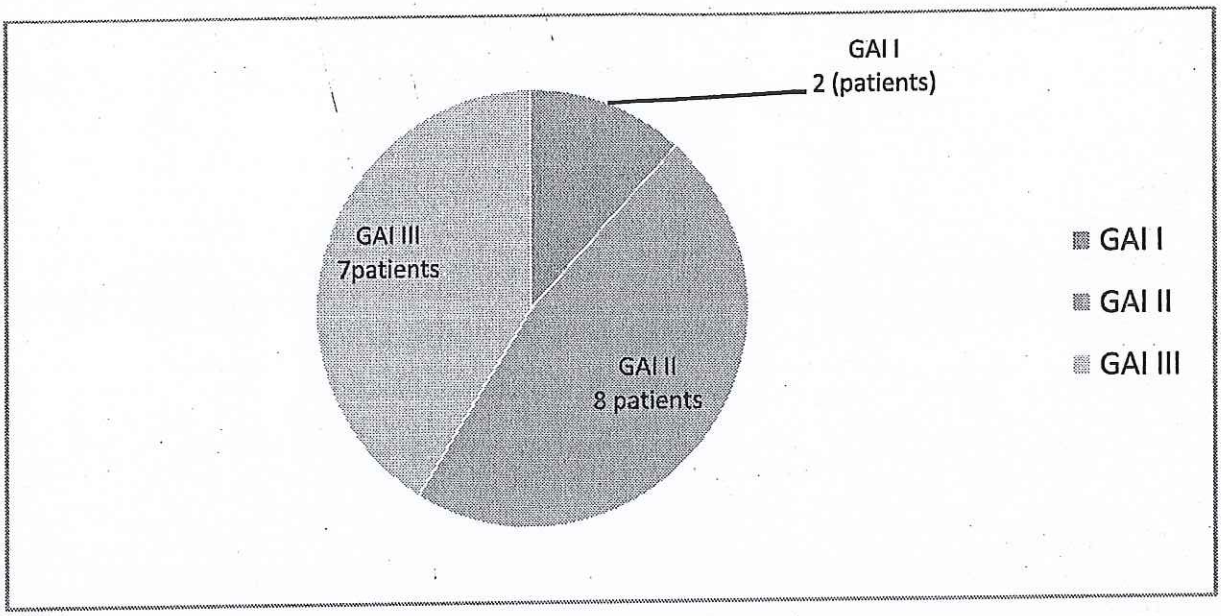


Figure 1 Degree of repositioning achieved according to Garden in patients with pseudoarthrosis

In all patients the fracture was repaired and fixed with 3 cannulated screws ina period of 4-15 days after injury. Of the total of 17 patients, posterior comminution was reported in the dorsomedial part of the femoral neckin 6 patients (35%). It wasthekey factor in joint instability, osteosynthesis failure, verus position, and the occurrence of pseudoarthrosis.

Regarding the position of the screws in the neck and the head of the femur, the following results were obtained. In 4 patients, a triangular construction with parallel screws was made, in 3 patients the screws were placed convergently, and in the remaining 4 "criss-cross" at an angle greater than 10 degrees. In this group of pseudoarthrosis, in 4 patients a "cut out" was registered whereas in 7 patients varus position of the head, and in 3 patients a broken implant. The irregular triangular construction wasalso implied as an important factor in the development of pseudoarthrosis.

In the group of patients with **avascular necrosis** (11 in total), in terms of the results achieved 3 patients had grade I, 4 patients grade II, and another 4 patientsgrade III. Thus, the risk factor in terms of the achieved repositioning was that excellent repositioning was achieved in only 3 patients (27%), and in the other 4 there was acceptable and unacceptable repositioning. These results show that an imperative to avoid complication such as aseptic necrosis is a good repositioning. Dorso-medial comminution was registered in 4 patients.

In 3 patients repositioning and osteosynthesis were performed in the first 48 hours, and inthe remaining patients,in a period from 5 to 10 days. The timing forthe surgery,from the injury and the occurrence of the fracture, also plays a significantrole in the occurrence of postoperative complications.

Regarding the position of the screws, they were placed parallellyin 4 patients,convergently in 3 patients andcriss-cross in 4 patients.

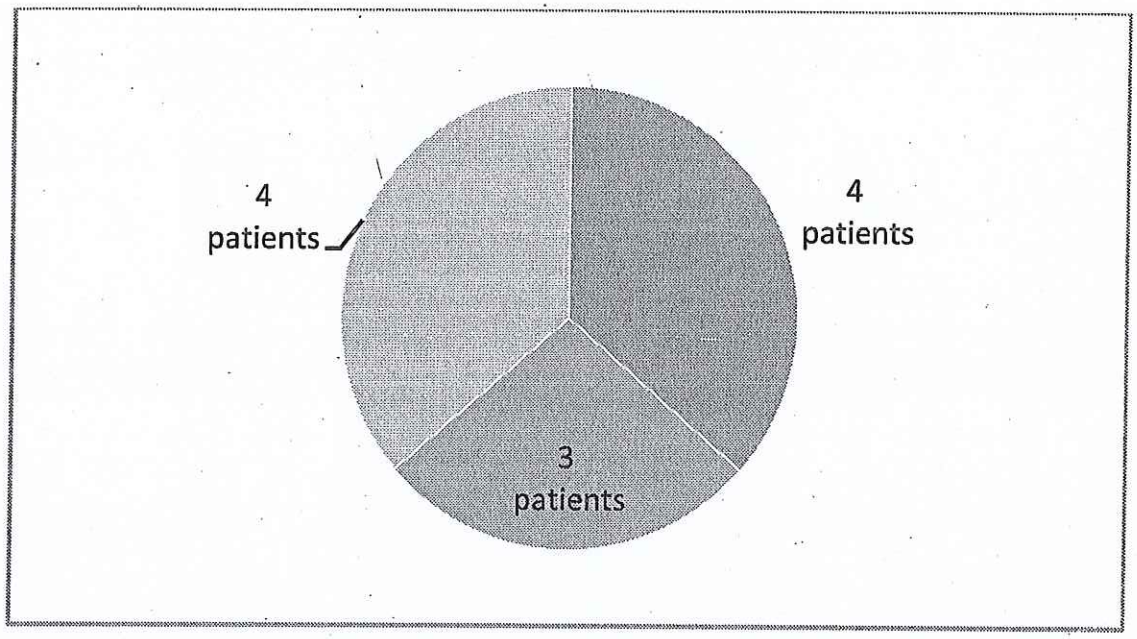


Figure 2 Position of screws in patients with avascular necrosis

In all patients with postoperative complications, this study assessed the quality of life for physical (PCS) and mental health (MCS). The same questionnaires were filled in as in the prospective study, every 6 weeks, at 3, 6 and 12 months. All 28 patients with pseudoarthrosis (17) and avascular necrosis of the femoral head (11) showed initial poor physical health outcomes; PCS 36.2 + - 4.6 in 17 patients with pseudoarthrosis and slightly better in 11 patients with AVN PCS-42 + - 2.6 during the first day of admission. At the control examinations of the patients with pseudoarthrosis we obtained the following results: at 6 weeks PCS showed a significant improvement (PCS- 48 + -4.6), and then a gradual improvement at 3 months (PCS-50 + -4.6), at 6 months (52 + -5.2) and at 12 months (54 + -6.2).

On the other hand, mental health remained stable without variations, initially MCS 40.2 + -8.6, after 6 weeks MCS 50 + -7.2, at 3 months 52 + -2.4, at 6 months 53 + -2.4, and at 12 months it rose to 54 + -2.5 (Figure 3).

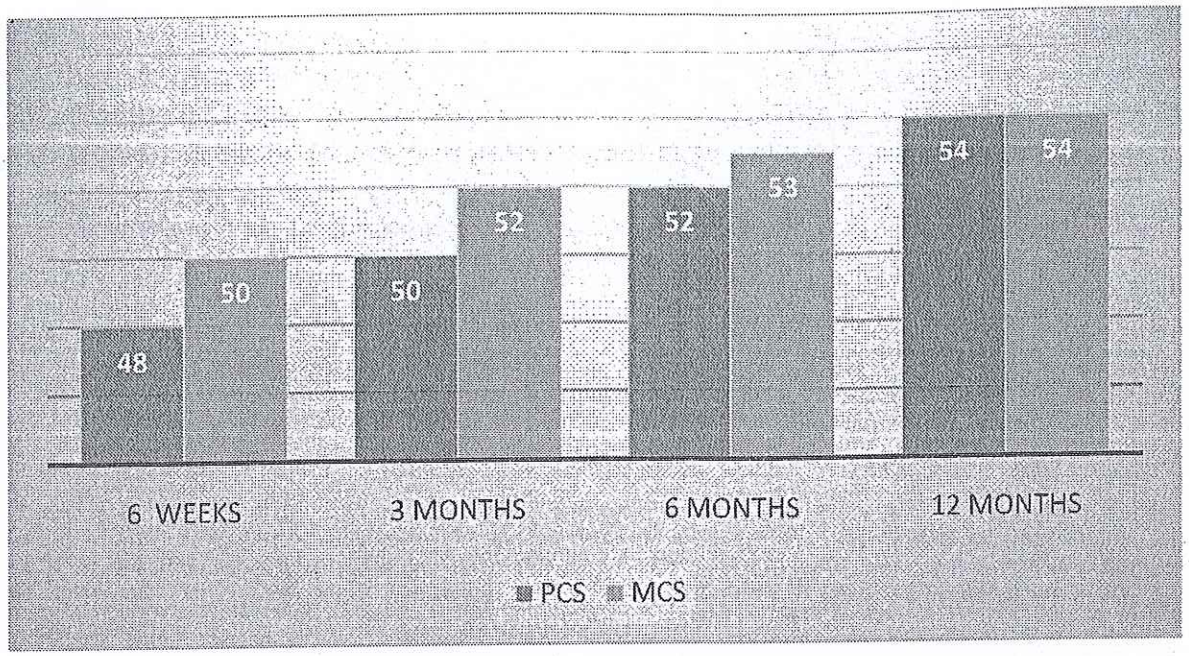


Figure 3 Demonstration of physical and mental health in patients with pseudoarthrosis. Improvement measured by SF-36 score. Unlike PCS, MCS showed stable value and smaller variations.

Patients with aseptic necrosis of the femoral head showed the following results of physical health (PCS): at 6 weeks 45.2 + -2.9, at 3 months 46.7 + -2.1, at 6 months 49.7 + -2.7 and at 12 months 51.2 + -3.1, while the mental health score showed the following results: at 6 weeks 46 + -1.7, at 3 months 47.2 + -2.5, at 6 months 50.2 + -3.1 and at 12 months 52.5 + -2.7 (Figure 4).

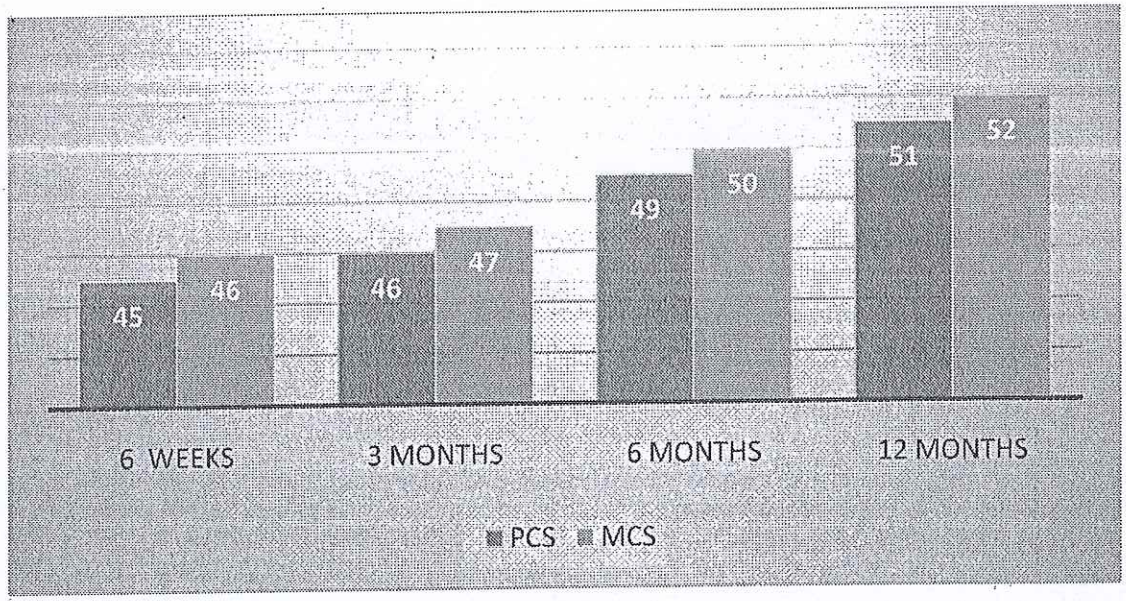


Figure 4 Demonstration of SF-36 physical and mental health outcomes in patients with aseptic necrosis of the femoral head

Discussion

Displaced fractures of the femoral neck in the younger population treated with osteosynthesis are fraught with multiple postoperative complications such as avascular necrosis, nonunion (pseudoarthrosis), fixation failure, and are deteriorating the quality of life of the injured making patients life-dependent (6, 15, 16). Their treatment is difficult, expensive, and related to frequent hospitalizations.

In the literature, the above complications are widely described with different incidence: pseudoarthrosis of 4% -59%, while aseptic necrosis of 10% -86% (17, 6, 16). This percentage of risk factors can be explained by the different selection of patients in terms of age, bone quality, type of fracture, method of repositioning, method of fixation construction and time of surgery after injury (sooner or later) (4, 5, 6,10).

Numerous risk factors have been described in the literature that could lead to postoperative complications such as: the quality of repositioning, presence of posterior comminution on the posterior medial part of the femoral neck, the time interval from injury to surgical treatment, the type of surgical fixation, the position of screws in the head, etc. (17, 5, 8, 9, 10, 11, 6, 17).

Fragment dislocation has been identified in all studies as a key risk factor for the occurrence of such complications. On the other hand, in nondisplaced Garden I and II fractures, such complications occur in a much smaller number (19, 5, 6, 17).

In this retrospective study comprising28 patients, analyses of key risk factors that could lead to the abovementioned complications (AVN- 11 and pseudoarthrosis –17)were performed. All patients underwent surgery due to displaced fracture Garden II, III, IV. The youngest patient was 40 years old and the oldest 65 years old. The meanage was 58 + -4.2

The results of the analysis showed that 17 patients with pseudoarthrosis at the time of admission showed reduced quality of life measured by the SF-36 score (PCS 36 + -4.2), in comparisonwith the normal population or with the healed fractures from the prospective study (PCS 52 + -9.4).

At the control check-upsat 3, 6 and 12 months, the physical health gradually improved, reaching the values of the normal (healthy) population.

The physical health results measured by SF score in the group of avascular necrosis of the femoral head showed slightly better results (PCS 42. + - 4.2) on the day of admission, whereas postoperatively on the control examinations the results showed improved values of the normal population or fixed fracture of the prospective study. The conclusion of our study in both groups (pseudoarthrosis 17 and AVN 11) showed worse results thanon the day of admission, and gradual improvement on the control check-ups, reaching values of the normal population and repaired fractures from our prospective study of femoral neck fractures.

The results obtained inthe group of AVN showed that the quality of life for mental health were slightly better (MCS 46.2 + - 8.6), and then on the control check-upsreached MCS 52 + -7.2.

According to Slobogeon *et al.* (16) the quality of life was analyzed in patients with femoral neck fracture, and the young population showed the worst PCS results in the first 6 weeks,but there was a gradual improvement at 3, 6, 12 months to normal population values. Physical health PCS from the SF score in patients with pseudoarthrosis had worse results than fractures that healed, MCS- 38.1 + -4.7, nonunion 49.5 + -5, and AVN 45.2 + -9.7.Mental Health Quality of Life (MCS)results

showed better MCS 50.4 + -7.2 scores with small variations in the first 6 weeks, and then values gradually increased.

According to Collange *et al.* (20) retrospective analysis of quality of life bythe SF-36 score in patients younger than 55 with a fractured femoral neck, showed a lower score in the advanced stage than in patients with pseudoarthrosis and avascular necrosis of the femoral head.

Results of this retrospective study regarding risk factors leading to complications showed pseudoarthrosis (in 17 patients) and avascular necrosis (in 11 patients).

The posterior comminutionwas present in the group of pseudoarthrosis in 6 patients and in the group of avascular necrosis in 4 patients. It is an important factor leading to instability, displacement of fragments, pseudoarthrosis, and avascular necrosis. The posterior comminution is also considered to be an indicator of fracture instability, described by a number of authors.

Therefore, in this type of comminution, the choice of treatment is placement of a bone graft, and if it is a larger defect and greater comminution, a more adequate choice of surgical treatment would be arthroplasty (endoprosthesis) (6, 21).

Loom Soon Kang *et al.*(22) registered pseudoarthrosis in 9 (10.7%) of 84 cases withsubcapitalfracture of the femoral neck, avascular necrosis in 6 patients, and 'fixation failure' in 7.1% and concluded that posterior comminution and the type of fracture are important factors in the development of avascular necrosis.

The correlation between the time interval from injury and surgery (repositioning and fixation) has been the subject of numerous studies worldwide. (21, 22, 5). Jain *et al.* (25) compared early fixation in the first 12 hours after injury with later fixation after 12 hours and found16% avascular necrosis in patients in the second group treated with internal fixation after 12 hours. No aseptic necrosis was reported in the first group of patients (surgically treated in the first 12 hours).

Swiontkowski *et al.* (5) achieved 100% repaired fractures when they performed the fixation in the first 8 hours of injury, but 30% of injured patients in their analyzed series had nondisplaced Garden II fractures.

Zetterberg *at al.*(23)also suggest that the timing of surgery is an important factor affectingthe final results.

The results of this retrospective study regarding the time of surgery showed that of the total number of 28, surgery was performed in the first 48 hours in 11 patients, and in the remaining patients during the following 3-10 days.

According to Upadhyay (6) *et al.*,of102 patients with displaced fracture (Garden III and IV) of the femoral neck in a young population aged 15-50 years, only three patients underwent surgery in the first 12 hours and the rest later during the first week. They believed that internal fixation was equally effective if performed in the first week after injury, no matter whether it would be performed in the first 48 hours or in the first week. However, they added that after a week of fibrosis around the fracture and migration of the distal fragment, it proximally complicated repositioning and required an open procedure.

Our viewregarding the timing of surgery is anatomical repositioning in the first hours, as soon as the condition allows, and not later than 48 hours. The patients in our study were operated during the first 48 hours.

The quality of the repositioning plays a major role in the repair of the fracture, the quality of life and the final outcome (2, 3, 4, 6). Anatomical repositioning allows for wider contact of the fractured fragments and thus better healing (6, 21, 22). However, in many cases it is difficult to achieve anatomical repositioning, especially in patients with

vertebral fracture and presence of dorsomedial comminution. Most of the fractures which re-dislocate are the ones with posterior comminution.
The results of this study showed that dorsomedial comminution is an important factor and plays a key role in the instability of fractures with subsequent complications. Recently, in such cases our choice has been a more adequate surgical treatment such as a total prosthesis - total endoprosthesis, most often non-cement or bone graft application.
In our retrospective study, assessing the repositioning achieved during surgery there was a first-degree repositioning only in 2 patients, Garden II in 8 patients and Garden III in 7 patients in the group of pseudoarthrosis, whereas in the group of aseptic necrosis Garden Iin 3 patients, Garden IIin 4 patients and Garden IIIin 4 patients.
On the other hand, regarding the fixation structure, in patients with pseudoarthrosis the screws were placed in parallel in 4 patients, convergent in 3 and crossed in 4 patients, and in patients with avascular necrosis, only in 3 patients the screws were placed in parallel, in 3 patients convergent and in 4 patients crossed. In 4 patients there was a "cut out", in 7 patients a "fixation failure" with a varus head position and in 3 patients broken screws. The correct position of the screws is parallel in both directions (AP and profile) and every other variant is a risk factor.
The parallel position provides a stable fixation of the spherical head on a wider base compared to the convergent structure which stabilizes a smaller area of the head and a fixation whichinstability causes complications (nonunion, pseudoarthrosis and AVN) (6).
The greater divergence of the screws from parallelism leads to a "criss cross",which does not allow good compression of the fragments and repair of the fracture (6).
Regarding the position of the screws according to the Shep criteria (17), in our series only in 5 patients did the screw position score 4 points, in 8 patients- 3 points and in 4 - 2 points. Proper screw positioning according to Shep criteria is crucial for fracture stability. The correct position is evaluated with 4 points, the position with 1 and 2 points leads to postoperative complications.
Asnis and Wanek(18) described avascular necrosis in 11% of their patients with a fractured femoral neck in atwo-year follow-up, increasing to 22% during an8-year follow-up. In their series, 25 of the patients had nondisplaced Garden I and II type fractures. The authors believe in the revascularization of the head during fracture repair after internal fixation.

Soto-Hall *et al.* (24) believe that stress on the reticular blood vessels is the main reason for the development of aseptic necrosis of the femoral head, even in nondisplaced Garden I and II fractures. Later Asmis and Wanec-Sguglione (18) described avascular necrosis in 20% of nondisplaced Garden I and II fractures,apart from the intraosseous repair that had occurred in the devascularized head.
This retrospective study has confirmed that risk factors such as posterior comminution, repositioning quality, unstable fixation, and incorrect position of the implants are the main factors leading to postoperative complications. They can be reduced oravoided with good injury assessment, anatomical repositioning, correct screw position, and stable fixation. In patients with posterior medial comminution of the femoral neck it generates instability and in such a case, the surgeon should choose a more appropriate surgical treatment such as arthroplasty (implantation of endoprosthesis).

Conclusion

The results of this study undoubtedly showed that:

• The main risk factors for postoperative complications (pseudoarthrosis and avascular necrosis) in this retrospective studywere: the achieved repositioning, the presence of a dorsomedial comminution and the position of the screws, as well as the time interval from injury to surgery.
• The timing of surgery is still a key factor in the occurrence of the abovementioned complications.
• Achieving a good or excellent repositioning has shown to be a key factor in the development of these complications in this retrospective study.
• The parallel position of the screws in the two plains (AP and Profile), the triangular construction and the good placement of the screws are imperative for the repair of the fracture and avoiding of postoperative complications (avascular necrosis, pseudoarthrosis)
• The presence of dorsomedial comminution is a major factor leading to the occurrence ofpostoperativecomplications. Therefore, the surgeon (Garden III and IV) should choose more appropriate surgical treatment such as cement-free full endoprosthesis. If the surgeon insists on osteosynthesis, then the resulting defect should be filled with a bone defect.

References

1. Askin SR, Bryan R. Femoral Neck fractures in young adults. Clin Orthop Relat Res. 1976;114:259-64.
2. Protzman RR, Burkhalter WE. Femoral Neck fractures in young adults. J Bone Joint Surgery Am. 1976;58:689-95.
3. Lu-Yao GL, Keller RB, Littenberg B, Wennberg JE: Outcomes after displaced fractured of the femoral neck: A meta-data analysis of one hundred and six published reports. J Bone Joint Surg Am1994;76:15-25.
4. Dedrick DK, Mackenze JR, Burney RE. Complication of femoral neck fractures in young adults. J Trauma. 1986;26:932-7.
5. Swiontkowski MF, Winquist RA, Hansen ST. Fractures of the femoral neck in patients between twelve and forty-nine years. J Bone Surg Am. 1984;66:837-846.
6. Upadhyay A, Jain P, Mishra P, Maini L, Gautum VK, Dhaon BK. Delayed internal fixation of fractures of the neck of the femur in young adults: A prospective, randomized study comparing closed and open reduction. J Bone Joint Surg Br 2004: 86(7)1035-1040
7. Haidukewuch GJ, Rothwell WS, Jacofsky DJ, Torchia ME, Berry DJ. Operative treatment of femoral neck fractures in patients between the age of fifteen and fifty years. J Bone Joint Surg Am. 2004;86:1711-6.
8. Holmberg S, Dalen N. Intracapsular pressure and caput circulation in nondisplaced femoral neck fractures. Clin Orthop Relat Res. 1987;219:124-6.
9. Keller GS, Laros GS. Indication for open reduction of femoral neck fractures. Clin Orthop Relat Res. 1980;152:131-7.
10. Swiontkowski MF. Femoral neck fractures: Open reduction internal fixation. IN: Wiss DA, Editor Master Techniques in Orthopaedic Surgery, Fractures. Philadelphia: Williams and Wilkins; 1998 pp. 213-21.
11. Mannineger J, Kazar GY, Fekete GY, Nagy E, Zolczer L, Frenyo S. Avoidance of avascular necrosis of the femoral head following fractures of the femoral neck, by early reduction and internal fixation Injury. 1985;16:437-48.

12. Garden RS. Low-angle fixation in fractures of the femoral neck. J Bone Joint Surg Br. 1961;43:647-63.
13. Garden RS. Reduction and fixation of subcapital fractures of the femur. Ortop Clin North Am 1974: 5:v683-712
14. Lagerby M, Asplung S, Ringgvist I. Cannulated screws for fixation of femoral neck fractrues. Acta Orthop Scand 1998;69:387-91
15. Slobogean GP, Sprague SA, Scott T, Bhandari M, Complications following young femoral neck fractures. Injury 2015;46(3): 484-491
16. Slobogean GP, Stockton DJ, Zeng B, Wong D, Bao-Tong MA, Pollak AN. Femoral neck fractures in Adults treated with internal fixation: Prospective multicenter Chinese Cohort. JAm Acad Orthop Surg. 2017;25(4):297-303
17. Schep NW, Heintjes RJ, Martens EP, Vam Dortmont LM, van Vugt AB. Retrospective analysis of factors influencing the operative results after percutaneous osteosynthesis of intracapsular femoral neck fractures. Injury 2004;35(10): 1003-9
18. Asnis SE, Wanek-Sgaglione L Intracapsular fractures of the femoral neck: results of cannulated screw fixation J. Bone Joint surg (Am) 1994;76A 1793-803.
19. Haidukewuch GJ, Rothwell WS, Jacofsky DJ, Torchia ME, berry DJ. Operative treatment of femoral neck fractures in patients between the age of fifteen and fifty years. J Bone Joint Surg Am. 2004;86:1711-6.
20. Collinge CA, Devinney S, DiPasquale T, Herscovici D, Sandres R. Outcomes of acute femoral neck fractures in young patients. 15th Annual Meeting of the Ortopaedic Trauma Association, Charlote, North Caroline 23, 1999.
21. Kang JS, Moon KH, Shin JS, Shin HE, Ahn HC, Choi GH. Clinical results of internal fixation of subcapital femoral neck fractures.Clin Orthop Surg 2016;8:146-152
22. Joon Soon Kang, Yoon Sang Jeon, Chi Hoonaln, Hoom RO. BMC Musculoskeletal Disorder 2016;17:264 doi 10.1186/s 12891-016-11237.
23. Zetterberg CH, Elmerson S, Andresson GB. Epidemiology of hip fractures in Goteborg, Sweden, 1940-1983. Clin Orthop Relat Res. 1984;191:43-52.
24. Soto-Hall Johnson RA Variation in the itra-articular pressures of the hip joint in injury and disease: a probable factor in avascular necrosis J Bone Joint Surgery (Am) 1964:46-A 509-16.
25. 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 Am. 2002;84:1605-12.