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METHOD OF CHOICE IN THE TREATMENT OF FEMORAL NECK FRACTURES IN SUBJECTS AGED OVER 65

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Of all femoral bone injuries, femoral neck fractures cause the largest number of surgical, medical and economic problems.

The research aimed to determine, within the tested sample, the benefits of the treatment of femoral neck fractures with primary femoral prosthesis.

The study involved 102 patients. The following parameteres were monitored: radiographic processing, BMD, times of sustaining the fracture, admission and surgical treatment, preoperative and postoperative complications, etc.

The average age of patients was 86.2 years. FNFs (femoral neck fractures) were classified using Garden's classification: Type I accounted for 0% of femoral neck fractures, Type II for 5.88%, Type III for 50.98% and Type IV for 43.14%. The time interval between injury and surgery amounted to 3.9 days and chronic illnesses were reported in 50% of the patients. Fractures were treated with internal fixation: 22.54% with Müller plate, 2.94% with screws; and with endoprostheses: Austin-Moore partial endoprosthesis was used in 50.98% of the patients, cemented total endoprosthesis in 4.9%, and non-cemented total prosthesis in 14.7%. General inhalation anaesthesia was used in 37.25% and spinal anaesthesia in 64.75% of the patients. 31.37% of the patients experienced complications. There were significant statistical differences in the time of verticalisation and full weight-bearing between the patients treated with endoprosthesis and those treated with internal fixation.

In less physically active elderly patients secondary surgeries can be avoided by performing primary arthroplasty. With displaced fractures there is a high risk of femoral head necrosis and pseudoarthrosis. In patients under the age of 65 who can endure a secondary operation in case of failure, the treatment of choice is internal fixation.

Patients over the age of 65 need to be treated with primary arthroplasty in order to avoid secondary operations. *Acta Medica Medianae 2010;49(3):5-10.*

***Key words**: femoral neck fracture, treatment, internal fixation, primary arthroplasty*

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Introduction

Of all femoral bone injuries, femoral neck fractures (FNF) cause the largest number of surgical, medical and economic problems. In 1950, the total number of FNFs in the world was 1.660,000, and the expected number for 2050 is 6.260,000 (1).

The first information on FNF came from Hippocrates, and the first treatment instructions came from Ambroise Paré in 1572 (2). The first book dealing with FNF was published in 1823 and was authored by Sir Astley Paston Cooper.

Until today, different FNF classifications have been described and adopted in some places: Pauwels (1935), Böhler (1938), Linton (1944), Evans (1949), Boyd (1953), Soer (1956), Garden (1961), Müller *et al.* (1990).

Today, the most commonly used classification is Garden's (3) and his division into undisplaced FNF (Garden Types I and II) and displaced FNF (Garden Types III and IV) has been accepted by many authors (3). Gautier showed a good correlation between the degree of displacement of fragments and secondary complications, such as nonunion of fractures (pseudoarthrosis) and segmental collapse (avascular necrosis) (4).

Vascularisation of the hip joint is realised from three sources:

- capsular vascularisation of circumflex femoris artery,
- endosteal vascularisation of metaphysary region of the femur and
- through ligament of the head of the femur (4).

With FNF, an increase in pressure within the joint resulting from the pressure of the hematoma from the damaged vascular network may purely mechanically jeopardise establishing an anastomosis and the function of the remaining intact circulation.

Caucasian women, compared to Caucasian men, run twice the risk of fractures, while the risk is the same for black women and men (5). The risk of fracture in Caucasian women is twice as high as in black women (6).

FNFs mostly occur in people over 65 years of age. In nursing homes that percentage runs as high as 40%. Etiologically speaking, most frequently these are 'small-scale' traumas; household falls account for 52.2%, street accidents for 35.5%, and other etiological factors for 12.4% of cases (7). In developed countries there are special communities, designed to be senior-friendly. Calcium- and vitamin D-deficient diet, long-term use of certain drugs, nicotine and alcohol, all constitute risk factors for FNF (8).

Aim

The research aimed to establish, within the tested sample, the advantages of treating femoral neck fractures in persons over the age of 65 with primary hip joint prosthesis over treating them with internal fixation by the Müller plate or screws.

Material and methods

The study was conducted on 102 patients treated at the Cantonal Hospital in Travnik between January 1, 2006 and January 15, 2010. Upon admission, FNFs were radiographically examined and the data on the Garden type of fracture were entered, the bone mineral density (BMD) in the first month following the injury was measured, and the times of sustaining the fracture, admission and surgical treatment were verified. Preoperative pathology was documented, as well as postoperative complications, duration of surgery, amount of blood consumption. The monitored parameters were as follows: early physical therapy, verticalisation, independent mobilisation with axillary crutches, partial and full weight-bearing on the operated leg and walking without crutches, hospital inpatient length of stay and the time of the commencement of rehabilitation in physical therapy. The results of the surgical treatment were assessed based on radiological follow-up. With internal fixation, the result was considered good if lateral angulation was less than 15 degrees, if there was no varus angulation and if contour lines in the calcar region were good. The position of the wedge plate was good if it was in the bottom half of the femoral head bone, below Ward's triangle, and if there was no sign of the head penetration. The position of the screw was good if the screw head laid between the middle and lower parts of the head in anteroposterior projection, and centrally or in the back of the neck in lateral projection, and with deviation not exceeding 10 degrees, and the distance between the screw top and the head cortex ranged between 5 and 10 mm. Any deviation from these parameters was considered a poor result. The result of the treatment with endoprostesis was considered good if the femoral anteversion of the endoprosthesis was between 5 and 10 degrees, and the prosthesis stem extended centrally, placed in a neutral position, for varus-valgus position. Any deviation from these parameters was considered a poor result.

Results

In the period between January 1, 2006 and January 15, 2010, 102 patients were treated for FNF at the Department of Orthopaedics and Traumatology of the Cantonal Hospital in Travnik. There were 58 women (55.9%) and 44 men (44.1%) in the treated group. The oldest patient was 96 and the youngest one was 64. The average age of the patients was 86.2; 71.5 for men and 82.7 for women. Statistically, with FNF, there is a significant age difference between the men and women in the tested sample.

FNFs were classified using Garden's classification. The treated group comprised 6 patients (5.88%) with a Garden Type II fracture, 52 (50.98%) with a Garden Type III fracture, and 44 (43.14%) with a Garden Type IV fracture.

The average time between admission and surgery was 4.1 days for patients who were treated for FNF with endoprosthesis, and 3.7 days for patients who were treated for FNF with internal fixation. The patients who were treated for FNF with endoprosthesis stayed in hospital for 15 days, and those who were treated with internal fixation for 19.2 days.

Long-term chronic illnesses were registered in 51 patients (50%) upon their admission. High blood pressure and heart problems were the most common ones, in 39 patients (38%), then there was diabetes mellitus in 7 (6%), renal failure in 2 (1.9%), and osteoporosis in 51 patients (50%). Since this is a retrospective and prospective study, it is likely that not all data were entered in the case history and the number of the chronically ill might have been higher. Chronic illnesses were present in 26 male patients (25%) and in 25 female patients (24%).

FNF was treated with internal fixation; 23 patients (22.54%) were treated with the Müller plate, 3 (2.94%) with screws, 56 (50.98%) with Austin-Moore partial endoprosthesis, 5 (4.9%) with cemented total endoprosthesis and 15 (14.7%) with non-cemented total endoprosthesis (Diagram 1).

The youngest patients with Garden Type II fracture were treated with the Müller plate and screws. The results were not encouraging. The protrusion of the plate into the acetabulum was registered in 2 patients (1.9%), screw fractures in 2 (1.9%), plate fractures in 4 (3.9%), infraction of internal fixation in 2 (1.9%) and pseudoarthrosis of femoral neck in 3 (29%).

Surgical procedures were performed under general inhalational anesthesia in 36 patients (37.25%) and under spinal anesthesia in 66 of them (64.75%).

In the primary surgical treatment of FNFs, complications were registered in 32 (31.37%) out of 102 patients (Diagram 2). The complications in question were pulmonary embolism in 5 patients (4.9%), trombophlebitis in 5 (4.9%), protrusion of the plate into the acetabulum in 2 (1.9%), screw fractures in 2 (1.9%), plate fractures in 4 (3.9%), bleeding where revision was done in 2 (1.9%), infection after internal stabilisation in 2 (1.9%), endoprosthetic infection in 3 (2.9%) and periprosthetic fracture in 2 (1.9%).

The following postoperative complications were registered after internal fixation: pulmonary embolism in 3 patients (2.9%), trombophlebitis in 3 (2.9%), protrusion of the plate into the acetabulum in 2 (1.9%), screw fracture in 2 (1, 9%), plate fracture in 4 (3.9%), bleeding where revision was done in 1 (0.9%), infection after internal fixation 2 (1.9%) and femoral neck pseudoarthrosis in 3 (2.9%).

Also, the following postoperative complications were registered after endoprosthesis implantation: pulmonary embolism in 2 patients (1.9%), trombophlebitis in 2 (1.9%), bleeding where revision was done in 1 (0.9%), endoprosthetic infection in 3 (2.9%), endoprosthesis luxation in 3 (2.9%) and periprosthetic fracture in 2 (1.9%) patients.

The average duration of an internal fixation surgery with screws amounts to 80 minutes and to 110 minutes with the Müller plate. The average duration of endoprosthesis implantation surgery amounts to as follows: Austin-Moore partial endoprosthesis 54 min, cemented total endoprosthesis 100 min, and non-cemented total endoprosthesis 90 min.

The average amount of blood given for internal fixation with screws is 1.150ml, and in case the Müller plate is used, it is 1.350ml. The average amount of blood given for endoprosthesis implantation is as follows: Austin-Moore 350ml, cemented hip joint endoprosthesis 1.050ml and non-cemented hip joint endoprosthesis 1.150ml.

Following internal fixation with screws, the full weight-bearing time amounts to 45 days from the day of the surgery and with the Müller plate it amounts to 42 days. Following endo-prosthesis implantation, the full weight-bearing time amounts to as follows: Austin-Moore 2 days, cemented total endoprosthesis 2 days, non-cemented total endoprothesis 3 days. By conducting the chi-squared test on the values obtained it was established that there was a significant statistical difference in the full weight-bearing time between people treated with internal fixation and those who had an endoprosthesis implanted.

The time of verticalisation of the patients after FNF surgery amounts to: 10 days after internal fixation with screws, 7 days after Müller plate, 1 day after Austin-Moore endoprosthesis implantation, 2 days after cemented total endoprosthesis, and 2 days after non-cemented total endoprosthesis. There is a significant statistical difference in verticalisation between the patients who underwent internal fixation surgery and those who underwent endoprosthesis implantation.

Hospital inpatient length of stay after internal fixation with screws and the Müller plate amounts to 18 and 15 days, respectively, and after implanting an Austin-Moore endoprosthesis, a cemented total endoprosthesis and a non-cemented total endoprosthesis it amounts to 14, 13 and 12 days, respectively.

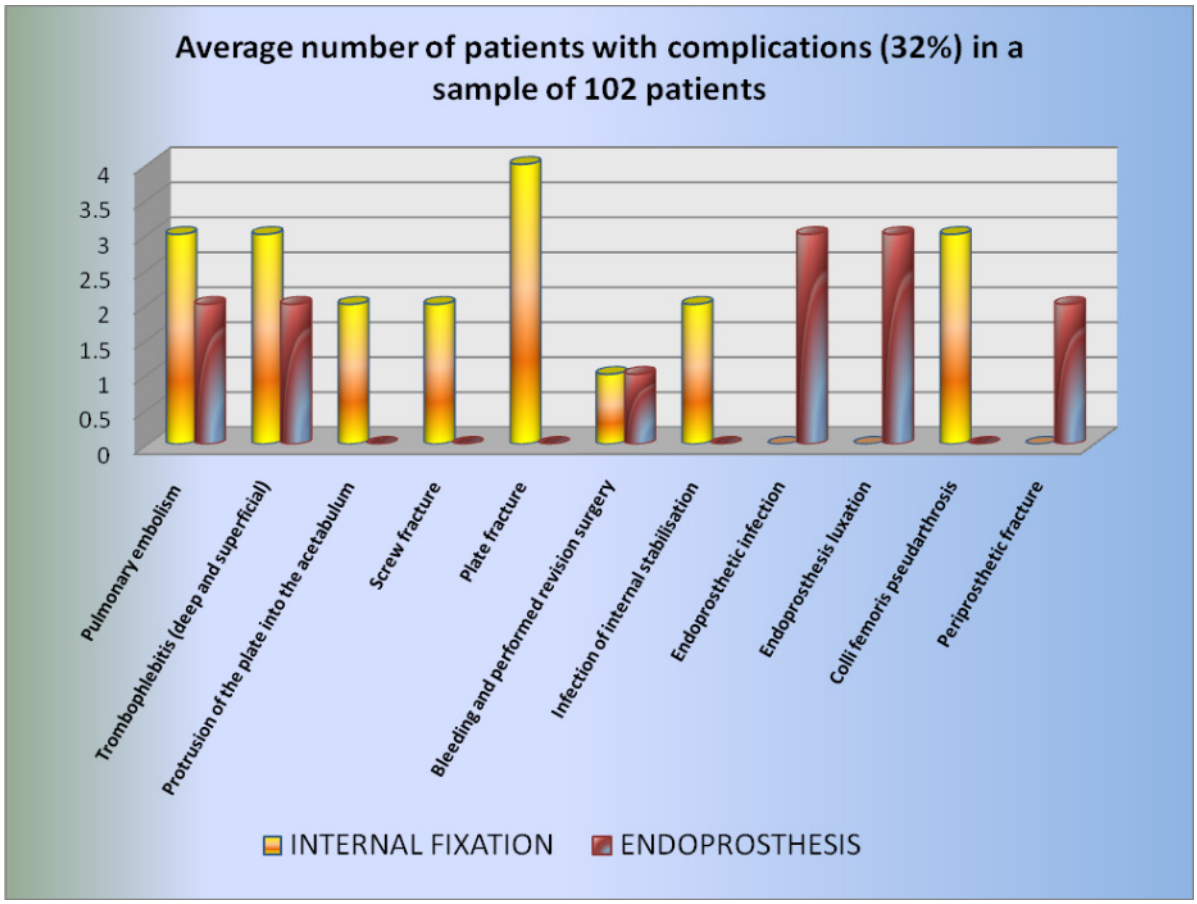

Diagram 2. Average number of patients with complications (32%) in a sample of 102 patients

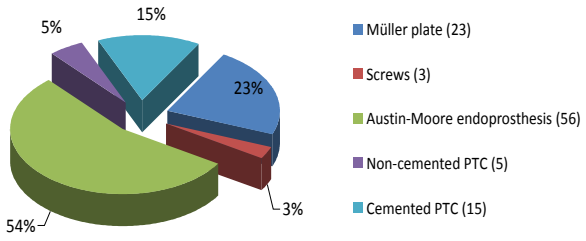

Diagram 1.Treatment of FNF with internal fixation and endoprosthesis

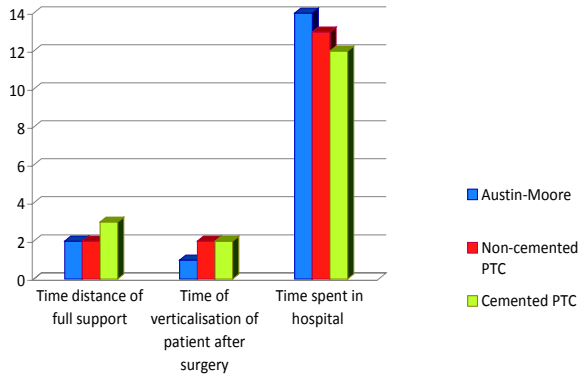

Diagram 3. With endoprosthesis

Out of 102 patients treated for FNF, in 47 (41%) of them a BMD test was performed in the first month following the fracture. BMD testing could not be performed at our Department, and people were required to come to the proper follow-up examination with the obtained relevant finding. Forty-seven patients had their findings done on Hologic QDR 4500 (S/N 4957 at the Fojnica Centre for Physical Therapy. The results were as follows: 21 patients (45%) had osteopenia and 26 (55%) had osteoporosis.

Discussion

Persons over the age of 65 are considered elderly and those over the age of 80 very elderly. There are still controversies about the advantages of certain surgical treatments of FNF. The age and need for physical activity are taken into account (8,9). In younger, healthy and physically active people, every attempt to treat should be directed at protecting and keeping the femur. In patients who are less physically active, i.e. the elderly, secondary operations can be avoided by performing primary arthroplasty. In displaced fractures there is a high risk of femoral head necrosis and pseudarthrosis (11,12). Johansson *et al*. (2000) and Tidermark *et al.* (2003) mention the incidence of femoral head necrosis in 10-20% of cases in the treatment of FNF with internal stabilisation and Lu-Yao *et al*. (1994) and Johansson *et al*. (2000) in their studies mention pseudoarthrosis in, on average, 20-40% of cases.

In patients who are under 70-75 years of age and can, in case of failure, endure a secondary operation, the treatment method is open reduction and internal fixation (10, 12). Patients who are over 70-75 years of age should be treated with primary arthroplasty in order to avoid secondary operations (12). In Europe, the population aged 65 and over made up 12-17% of people in 2002, and the estimates are that they will make up 20-25% in 2025 (4).

In terms of all trauma cases, hip fractures make up 10% of all fractures. Their prevalence is different in developed and undeveloped countries. The reason for that is the fact that in 2002 the population aged 0-15 made up 30% of the population in developing countries (11).

In Croatia, about 15% of postmenopausal women have osteoporosis (approx. 130.000) and about 30% (260.000) have osteopenia. Less than 10% of patients are treated. According to the research undertaken in Croatia involving more than 10.000 persons over the age of 50, it was established, by using ultrasound to measure the heel bone density, that the Primorje-Gorje County was least affected by osteoporosis (30.1%) while the Zagreb County was most affected (42%).

In the first year following the fracture, 50% of patients with hip fractures experience a significant reduction in physical capacity, 25% of them need long-term home care, and 19% need accommodation in inpatient facilities (6). The mortality caused by hip fractures within the first year from sustaining the fracture amounts to between 12 and 20% and is almost the same in countries with very different healthcare standards (11).

The increase in the elderly population and urbanisation of the world outside Europe and North America will result in the increase in FNFs. In 1977, for example, there were 213.000 FNFs, i.e. 98 FNFs per 100.000 people, in the USA; in Finland there were 44 FNFs per the same number of people; 42.8 in cities in England, and 59.1 in Jerusalem. Results presented by many authors in the world show that the increase in the incidence of FNF has stopped (Levi, 1997), as reported by Lofman *et al.* in 2002.

Some researchers believe that in 30% of the elderly population an endogenous disorder is the primary factor that causes falls and fractures. The endogenous factors that are primarily referred to are: cerebrovascular insult, acute heart disease, visual impairment, diabetes (10).

There are major statistical differences between races. For example, in Hong Kong, where the Chinese make up 97% of the population, there are 31.5% of FNF cases per 100.000 population, 20.3% in Singapore, and 5.6% in Johannesburg (9).

The FNF percentage varies depending on the season; it is more common in winter (37%) and less common in summer (15%) (4).

According to Boston and his articles published in 1983, bilateral FNF occurs in 10.6% of cases. The second hip fracture occurs within one year of the first hip fracture.

Bilateral simultaneous fractures are extremely rare. Atkinson *et al*. publicized 9 cases reported by 1980. These fractures occur in younger patients, with an average age of 33 years, and are the result of a jump from height or the electric shock therapy for psychiatric patients.

A growing number of elderly people today live a healthy life, they are more active, and consequently live longer. Despite an increase in the average age of FNF patients, the mortality rate has

not changed significantly and it ranges between 2 and 46% (6,9,10).

In 1994, Lu Yao *et al*. published an analysis which did not find a significant difference in complications between internal fixation and primary arthroplasty for FNF. They, however, noted a small difference in mortality one month after primary arthroplasty compared to internal fixation (5,7). Rogmark reported in 1996 that, in persons over 80 years of age, the perioperative mortality pertaining to arthroplasty was 4.8% as compared to 8.6% mortality pertaining to internal fixation. Neander (2000), Johansson *at al*. (2000), Ravikumar and Marsh (2000) recommend total arthroplasty for active patients over 65-75 years of age. Puolakka *at al*. recommend in their study the cemented partial endoprosthesis for inactive patients over 75-80 years of age.

Jakob reported the radiological diagnosis of aseptic necrosis in more than 75% of cases three years after the fracture, while Old and McGrory reported a case of diagnosing aseptic necrosis seven years after the initial FNF treatment. Johansson reported pseudarthrosis in 12% of cases when in 2000 he presented his experience in FNF treatment and the results obtained. In 2003 Tidermark reported pseudarthrosis in 23% of cases and aseptic necrosis in 13% of cases, and in 2002 Rogmark reported pseudarthrosis in 28% of cases and aseptic necrosis of the femoral head in 12% of cases.

The results of prospective studies concerning the use of unipolar and bipolar partial endoprosthesis indicate that the right choice for the elderly population is the use of the cheaper non-cemented unipolar prosthesis (Ong 2002, Bezwada 2004, Kamada 2005). According to Cornell, a larger rotation and abduction range of motion and an improved speed of walking are achieved by using the bipolar endoprosthesis, while Calder argues that a greater degree of return to the pre-injury state is achieved by using the unipolar prosthesis. As opposed to these results, Wathne argues that there is no significant difference between the use of unipolar and bipolar endoprosthesis.

Emery has studied the comparative results of hip hemiarthroplasty with cemented and non-cemented prostheses and showed that the cemented prosthesis is more stable and durable. Murphy and Oh have examined adaptive changes in the femoral bone structure immediately after implantation. Of the implanted prostheses, 20% saw revision surgeries within the first 5-6 years following the intervention, while the functional results in 18% of them were unsatisfactory (12). According to Neander, deep infection is less common after closed reduction and internal fixation, and it ranges between 0-2.8%.

The need to remove osteosynthetic material is indicated by a painful hip resulting from protruding screws or screws sliding out after fracture healing. Alho *et al*. reported in 1999 that they had performed reoperations in 7-8% of cases (10).

According to Smrke, partial endoprosthesis provides a better, greater range of motion compared to internal osteosynthesis. Younger patients treated with total arthroplasty were found to have better results compared to patients treated with partial arthroplasty (1). Patients treated with total arthroplasty experience less pain, have a better mobility, and also a lower re-intervention percentage compared to internal fixation.

Poor results are reported by Ravikumar and Marsh, who compared total arthroplasty with internal fixation and partial arthroplasty, noting the displacement rate ranging between 12.5-20%.

Parker and Pryor favour internal fixation and report fewer postoperative infections, lower treatment costs, lower mortality rate following internal fixation with the DHS screw. Rogmark reports that the postoperative mobilisation, walking ability and total functional condition are better following arthroplasty. Jónsson *et al.* in their study report that compared to patients treated with internal fixation, patients treated with total arthroplasty have better everyday activity functions and need less outdoor aid. Bachrach-Lindström recommend total arthroplasty as a safer method for the treatment of FNF in the elderly without increased postoperative mortality (9,8).

The functional status on admission and functional recovery may be used to predict the efficiency of geriatric rehabilitation of FNF patients. Many of the aforementioned studies agree in terms of the functional outcome of internal fixation and partial arthroplasty (5,6).

Lower age range varies in different studies between 65 and 75 years, and closed reduction and internal fixation are recommended for lower age patients (4). Nilsson is of the opinion that the risk of failure after IF increases with age. It is very important to distinguish between the biological and chronological age of patients (4,5).

As Raaymakers claimed in 2006, the annual treatment costs in the USA reach up to 10 billion dollars (2,6).

Conclusion

1. The incidence of multiple diseases, which affect each other and which in surgical treatment significantly affect the outcome, is quite common in senior age patients.
2. Spinal anaesthesia should be given preference in senior age whenever possible because it carries a lesser risk, there are lesser cardio-depressor and arrhythmogenic effects on the heart, the possibility of thromboembolic events decreases, and the recovery is faster.
3. There is a lesser need for additional blood and blood derivatives in endoprosthesis implantation, which is a great benefit for patient recovery.
4. The time to achieve full weight-bearing on the operated leg with an implanted endoprosthesis is significantly shorter, which is of great importance to the consolidation of the general condition and the quality of life.
5. Post-operative complications in FNF treatment with osteosynthetic material are statistically important, and given all the above said, the treatment of choice in elderly FNF patients (over 65 years of age) is endoprosthesis implantation. At the same time, the right choice of endoprosthesis is of great importance as well, and the following should be taken into account: age, other diseases, and other factors.

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IZBOR METODE LIJEČENJA PRELOMA VRATA BUTNE KOSTI OSOBA STARIJIH OD 65 GODINA

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Od svih povreda butne kosti, najviše hirurških, medicinskih i ekonomskih problema stvaraju prelomi vrata butne kosti.

Ciljevi ovog istraživanja bili su da se u okviru ispitivanog uzorka utvrde prednosti liječenja preloma vrata butne kosti primarnom protezom.

Ispitivanje je sprovedeno na 102 bolesnika. Praćeni su sledeći parametri: radiografska obrada, BMD, vrijeme preloma, prijema i hirurškog liječenja, preoperativne i postoperativne komplikacije itd.

Prosječna starost ispitanika je 86,2 godine. Klasifikacija PVBK (prelom vrata butne kosti) izvršena je po Gardenu. U analiziranoj grupi bilo je: tip I preloma vrata butne kosti 0%, tip II 5,88% , tip III 50,98% i tip IV 43,14%. Vrijeme od povrede do operacije iznosi 3,9 dana, hronična oboljenja imalo je 50% ispitanika. Prelomi su liječeni internom fiksacijom, Müler-ovom pločom 22,54%, zavrtnjima 2,94% i endoprotezama: parcijalna endoproteza Austin Moor 50,98%, totalna cementna endoproteza kod 4,9% i totalna bescementna proteza kod 14,7% ispitanika. Opšta inhalaciona anestezija korišćena je u 37,25% a spinalna 64,75% ispitanika. Komplikacije je imalo 31,37% bolesnika. Statistički su značajne razlike u vremenu vertikalizacije i punog oslonca kod operisanih sa endo-protezom u odnosu na internu fiksaciju.

Kod slabije fizički aktivnih starijih bolesnika, sekundarne operacije mogu biti izbjegnute primarnom artroplastikom. Kod dislociranih preloma postoji veliki rizik za nastanak nekroze glave butne kosti i pseudoartoze. Kod bolesnika koji su mlađi od 65 godina, koji mogu izdržati sekundarnu operaciju u slučaju neuspjeha, izbor liječenja je interna fiksacija.

Bolesnike starije od 65 godina treba tretirati primarnom artroplastikom radi izbjega-vanja sekundarne operacije. *Acta Medica Medianae 2010;49(3):5-10.*

Ključne reči: *prelom vrata butne kosti, liječenje, interna fiksacija, primarna artroplastika*