

FRACTURES OF THE PROXIMAL FEMUR IN THE ELDERLY

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SUMMARY – Fractures of the proximal femur are a substantial problem in the elderly. These fractures primarily are due to bone fragility in the elderly caused by osteoporosis. This population is burdened with numerous chronic illnesses that aggravate and complicate surgical treatment of the injured. According to latest figures, death rates among patients with these fractures are by 15% higher than in those free from these injuries, and 20% of the injured will never be able to walk independently again. According to our own experience and literature data, surgical treatment significantly reduces the mortality of the injured and improves their quality of life by providing by far better functional results than conservative treatment. Results of operative treatment for proximal femur fractures were compared between two periods of time at a 10-year interval (1988/1989 and 1998/1999). Comparison between these two time periods showed the frequency of hospital admission and operative treatment for this pathology to have increased by more than 100% in 10 years, so that at present this group of patients account for more than 45% of the capacity and operative schedule of the Division of Traumatology, Department of Surgery, Sestre milosrdnice University Hospital in Zagreb. During the latter 2-year period (1998/1999), there were 372 injured in total, 78 (21%) of them male and 294 (79%) female, mean age 73 years (69 in male and 79 in female patients). The mean duration of hospitalization was 15 days with 5-day waiting for the operation. During the same time period, eight (2%) patients were treated conservatively. A 2.5% (n=9) perioperative mortality rate was recorded. Fracture of the neck of femur was found in 152 (41%) patients; 47% of them were treated by use of partial hip prosthesis, 10% with total hip prosthesis, and 42% with a 130-degree angle plate. Out of 205 pertrochanteric fractures, 130-degree angle plate was used in 50%, 95-degree angle plate in 22%, and dynamic hip screw in 28% of cases. Operative treatment combined with a well planned rehabilitation program consistent with the type of surgery and individual patient condition has evident and great advantages, and has been recognized as the treatment of choice for this pathology.

Key words: *Femoral fractures, therapy; Femoral fractures, surgery; Fracture fixation; Age factors; Aged*

Introduction

Fractures of the proximal part of the femur in elderly patients usually result from a fall, low energy pattern, or injury. Clinical signs and symptoms on presentation may be minor in a patient who has an incomplete, impacted or nondisplaced fracture. In displaced femoral neck frac-

tures, shortening and external rotation of the limb occur, the patient suffers severe pain, and any attempt to move the hip causes pain. The patient will be most comfortable with a pillow placed beneath the knee and the hip moderately flexed. In displaced intertrochanteric and subtrochanteric fractures, displacement is greater.

Radiographic evaluation by standard anteroposterior and lateral radiographs of the hip is essential for assessment of the proximal part of femur fractures. Nondisplaced fractures that cannot be seen on plain radiographs are apparent on magnetic resonance (MR) image immediately, and on bone scan after three days.

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A negative MR result ensures the surgeon that no fracture of the hip is present. Garden's classification of femoral neck fractures is based on the degree of displacement evident on anteroposterior radiograph of the hip. Grades I-IV correspond to both the prognosis of healing and rate of osteonecrosis³⁻⁵. An alternative classification system proposed by Pauwels is based on the angle formed by the fracture line and horizontal plane. Neither of these classification systems takes into account the rotational alignment of the head or the degree of posterior comminution. The classification of intertrochanteric fractures may be simple in stable or unstable fractures. Concerning unstable fractures, a large segment of the posteromedial wall is broken free, with comminution posteriorly, and the outcome may be varus collapse, malunion, or non-union. A modification of Boyd and Anderson classification includes four basic types of intertrochanteric fractures⁶, as follows: type I, non-displaced, stable fracture without comminution; type II, stable, minimally comminuted and displaced fracture. Reduction of these fractures leads to a stable construct. Stable fractures heal well with any type of fixation device; type III, unstable fracture with a large posteromedial comminuted area; and type IV, usually unstable fracture with a subtrochanteric component. Intertrochanteric fracture with a subtrochanteric component is most difficult to fix.

Subtrochanteric fractures of the femur account for 10% to 15% of the fractures of the hip and are among the most problematic ones to treat, because they are predisposed to a high rate of failure. Many systems of classification of fractures of the proximal part of the femur have been proposed. Some are complex and some are simple. A practical system is based on the method of treatment, dividing these fractures into two groups⁷. In type I or high subtrochanteric fracture, the fracture line extends into the lesser trochanter. Since the lesser trochanter is broken off, fixation must be done with either a sliding hip screw or second generation locking nail. In type II or low subtrochanteric fracture, the lesser trochanter remains intact, and the fracture can be treated with a first generation locking nail (a nail with a single proximal locking screw) that is positioned retrogradely from the great trochanter to the lesser trochanter. Both types of fracture may be either simple or comminuted with extension into the shaft.

Treatment of femoral neck fractures

The optimal timing for internal fixation of femoral neck fractures remains controversial⁸. Animal studies

show that a minimum increase in the intracapsular pressure occludes blood supply to the femoral head⁹. We also believe that it is advantageous to reduce and stabilize the femoral neck fracture as soon as the patient is medically stable. The treatment of the fracture depends primarily on the patient's age and degree of displacement. A patient with nondisplaced or minimally displaced femoral neck fracture is best treated with internal fixation to prevent displacement, and to decrease the associated risk of osteonecrosis and non-union¹⁰. A patient with displaced femoral neck fracture is at a high risk of both osteonecrosis and non-union. Several authors have reported on a 20% rate of non-union and 25% rate of osteonecrosis on an average¹¹.

The management of displaced femoral neck fractures is based on the age and physical demands of the patient. A person's biological age is not always the same as the chronological age. There is no definite evidence for the age at which open reduction and internal fixation should be abandoned in favor of prosthetic replacement to preserve femoral head. However, a patient who is physiologically older than 75 should be considered a candidate for primary prosthetic replacement to avoid a second operation. Prosthetic replacement may also be chosen for a patient who has a severe pre-existing hip disease. The choice of prosthesis depends on the patient's walking requirements and degree of associated hip disease. A one-piece hemiprosthesis without cement may be used in a patient who cannot walk. It is optimal for sedentary patients because weight-bearing on the prosthesis is associated with a high prevalence of both pain in the thigh and lateral acetabular protrusion. A bipolar prosthesis with cement has been used in patients who are restricted to walking about the house¹². A modular hemiprosthesis with a solid exchangeable head on the femoral stem is currently available. Total hip replacement is the treatment of choice for femoral neck fractures associated with severe osteoarthritis, rheumatoid arthritis, or cancer. A displaced fracture that cannot be reduced in a closed fashion in an elderly patient who has high functional requirements and is able to walk about the community (generally, a patient who is less than 65 years old and has few medical problems), or in a younger patient should be treated with open reduction and internal fixation. In a more fragile, elderly patient, the surgeon should proceed with prosthetic replacement. For fixation of a well reduced femoral neck fracture we use a simple technique of percutaneous or an open technique with cannulated screws.

Stability at the site of fracture is maximized by the placement of three screws in a triangular configuration¹³. Care must be taken to place the screws at an angle of 130-135 degrees to the femoral shaft. An alternative method is a 130-degree blade plate sec AO. Major complications include non-union and osteonecrosis. In an elderly patient who is able to walk, non-union is treated with total hip replacement, however, in a younger patient Pauwels valgus osteotomy and repeat fixation are used¹⁴.

In a younger patient with collapse of the femoral head or non-union, total hip replacement is indicated. Osteonecrosis is usually partial and does not involve the entire femoral head. If the patient is asymptomatic, no additional treatment is indicated. If the patient is symptomatic and able to walk, total hip arthroplasty is indicated. Total hip replacement should be reserved for a patient whose fixation has failed (Figs. 1 and 2).

Treatment of intertrochanteric fractures in the elderly

Sliding devices that allow for impaction of the fracture fragments according to biomechanical clinical studies produce results that are equal to or better than those of osteotomies, and remain the mainstay of treatment today¹⁵. We use dynamic hip screw (DHS) of 135 to 155 degrees. Successful treatment of intertrochanteric fractures depends on stable osteosynthesis, and on the degree of osteoporosis of the bone, fracture pattern, and correct use of the fixation device. For this reason, many of these fractures must be postoperatively protected with limited weight-bearing. Primary arthroplasty in intertrochanteric fractures are difficult and associated with a high rate of dislocation. An arthroplasty can be easily performed later when the fracture has healed. The value of prophylactic

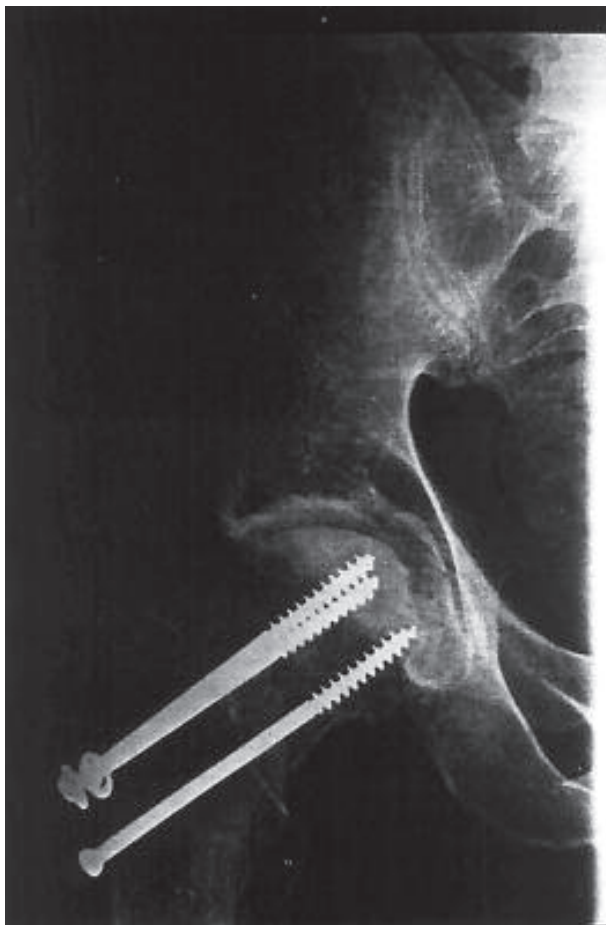


Fig. 1. A large cannulated cancellous bone screw for the management of femoral neck fracture.



Fig. 2. Total hip prosthesis for the management of femoral neck fracture.

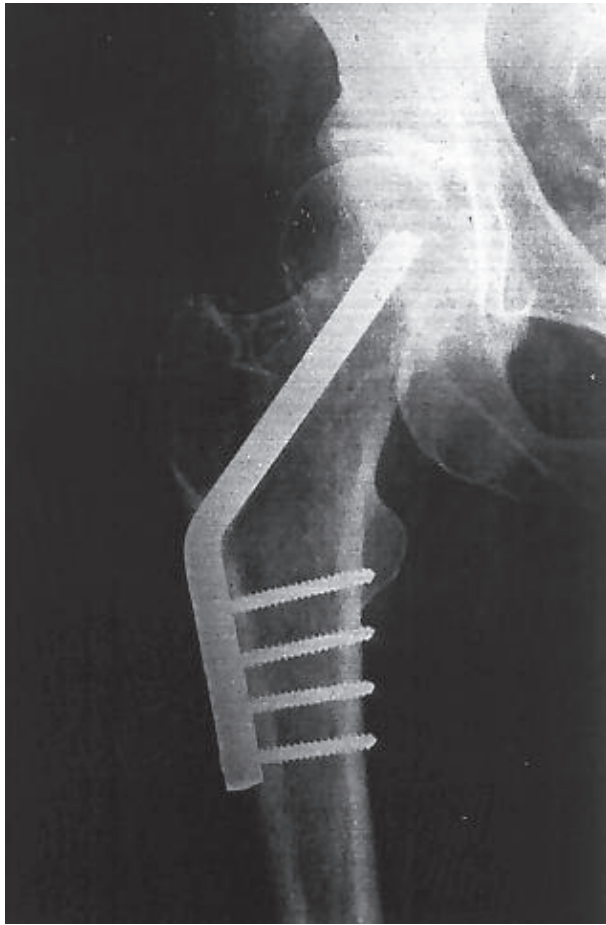


Fig. 3. A 130-degree angle plate used for fixation of intertrochanteric, and occasionally for subtrochanteric and femoral neck fractures.



Fig. 4. Dynamic hip screw (DHS) has found application in the management of intertrochanteric and subtrochanteric fractures.

use of antibiotics has been proved. The rate of infection is less than 1% with the use of broad spectrum antibiotics, initiated before the operation and administered for at least one day postoperatively. Stable fixation of the fracture, which allows for rapid mobilization of the patient, is the most effective method for the prevention of thromboembolic disease. For thromboembolic prophylaxis, we recommend low molecular-weight heparin. If good fixation has been achieved, full weight-bearing is allowed. If the fixation is unstable, as when the bone is osteoporotic, only partial weight-bearing is permitted. The patient is allowed to sit one day after the operation. On the second to third day postoperatively, the patient is allowed to walk between parallel bars, bearing weight on the injured extremity as tolerated. As the bone is osteoporotic or osteosynthesis is poor, delayed weight-bearing with the use of

toe-touch is necessary only until the callus is formed, which should be seen on the radiograph. Additional radiographs should be made four to six weeks, then six months after the fracture. Complications of fixation of intertrochanteric fractures are minimal compared with those associated with fixation of hip fractures. The rate of failure with the use of a collapsible hip screw is less than 5%. With the prophylactic use of antibiotics, the rate of infection is less than 1%. Osteonecrosis is extremely rare, occurring in 1% of cases. The rate of non-union is less than 10%¹⁶. The most common mode of non-union management is removal of the device, renailling in a more valgus position, and insertion of a cancellous bone graft. A blade plate can be used. If the acetabulum has been injured by a protruding osteosynthetic implant, total hip replacement is the treatment of choice.

Treatment of subtrochanteric fractures in the elderly

These fractures result from low-energy trauma such as a fall in elderly patients. The orthopedic surgeon has a multitude of internal fixation devices and techniques available for use in the management of subtrochanteric fractures. If the piriform fossa is involved in a proximal (type I) subtrochanteric fracture, a sliding hip screw should be used. Indirect reduction with minimal periosteal stripping should be used. Bone grafting of medial cortex is performed if this area is comminuted. In case of subtrochanteric fracture with intact lower lesser trochanter (type II), the first and second generation locking nails are recommended⁷.

Weight bearing is delayed until the callus is formed. The patient is then allowed to increase weight bearing gradually as tolerated (Figs. 3 and 4).

Patients and Methods

Hospital and clinical records of all elderly patients who had undergone surgical treatment for proximal femur fractures were retrospectively reviewed. Patients aged ≥ 65 who had been admitted to the Department of Surgery, Sestre milosrdnice University Hospital, for hip fracture were included.

Two 2-year periods were observed: 1988/1989 (group 1) and 1999/2000 (group 2). Groups 1 and 2 included 173 and 372 patients, respectively, with proximal femur fractures treated surgically at the Division of Trauma, Department of Surgery, Sestre milosrdnice University Hospital, by osteosynthesis and partial or total hip prosthesis (Table 1).

Group 1 included 173 patients, 67% female and 33% male patients, mean age 74 years. Ten years later, group 2 had 372 patients, 78 (21%) male and 294 (79%) female patients, mean age 73 years (69 and 79 years for male and female patients, respectively). It should be noted that no significant changes had taken place in-between the two time periods either in number of hospital beds or in number of traumatologists employed. Concerning the mechanism of injury, fall at home (53%) or outdoors (20%) predominated. The rest referred to a wide variety of causes, most of them (13%) related to alcohol consumption. There was no significant difference in the cause of proximal femur fracture between the two patient groups. According to the anatomical location of fracture, there were 41% of pertrochanteric, 37% of femoral neck, and 6% of subtrochanteric fractures in group 1. In group 2, 55% of

the fractures were pertrochanteric, 41% femoral neck, and 4% subtrochanteric fractures.

Surgical treatment consisted of preoperative management, repositioning and retention of the fractured fragments by Kirschner's extension through tibial tuberosity, and surgical treatment of the fracture. In group 1, the length of hospital stay was 18 days, with a preoperative period of 7 days. In group 2, the duration of hospitalization was 15 days, with a preoperative period of 5 days.

In group 1, the methods of treatment were distributed as follows: osteosynthesis with a 130-degree angle plate in 77%, osteosynthesis with a 95-degree angle plate according to AO principles in 19%, total hip prosthesis in 2%, and conservative treatment because of contraindications for surgery in 2% of patients. In group 2, there were 152 patients with fracture of the femur neck. Partial hip prosthesis implantation was used in 47%, total hip prosthesis implantation in 10%, osteosynthesis with a cannulated screw in 1%, and osteosynthesis with a 130-degree angle plate in 42% of these 152 patients. In the subgroup of 205 pertrochanteric fractures, 28% were treated with DHS, 22% with osteosynthesis with a 95-degree angle plate, and 50% with osteosynthesis with a 130-degree angle plate. A 95-degree angle plate and DHS screw were used for subtrochanteric fractures.

In group 1, complications during the early postoperative period included deep venous thrombosis in 8% and wound infection in 1.7% of patients. In group 2, deep venous thrombosis was recorded in 5% and lethal pulmonary embolism in two cases. Postoperative wound infection occurred in four (1%) patients in total, with the development of posttraumatic osteomyelitis in one patient after a subtrochanteric fracture following reoperation for implant fracture.

We included pseudoarthrosis, aseptic necrosis and implant fracture due to material wear and tear, and inadequate physical therapy in the category of late complications. In total, there were 24 patients with late complications, including aseptic necrosis of the femur head and neck in 17, pseudoarthrosis in five, and implant fracture in two patients. The complications were mostly surgically treated. So, reosteosynthesis was performed in 12 and total hip prosthesis implantation in eight patients, whereas in four patients the osteosynthetic plate was merely removed. This relatively small number of complications was due to the fact that only 89 (52%) patients from group 1 were available for follow-up. In group 2, 204 (55%) patients were available for follow-up. Eighteen (5%) of them had aseptic necrosis of the femur head, seven (2%) had

pseudoarthrosis of the femur neck, and 18 (5%) suffered implant fractures (3 partial hip prosthesis fractures, and the rest were fractures of the 130-degree angle plate).

Lethal outcome following these procedures in the elderly has been on a significant decrease. Before the introduction of Smith-Peters nail, the mortality rate was 75%, having been reduced to about 30% thereafter. During the 1980s, a one-year mortality of 20% was recorded¹⁷. Smiljanić states that the mortality with conservative treatment with extension in these patients is 30%, and is halved in those operated on¹⁸. Recent studies report on the mortality rate in surgically treated elderly to be by about 15% higher than in the general population of the same age¹. In our study, the early mortality during the first month was 2.1% in group 2.

Rehabilitation includes preoperative and postoperative procedures that are individually planned according to the type of surgery and patient's general condition. Rehabilitation is performed and supervised by a physiotherapist on our ward. In most cases, patients are transferred for further treatment to inpatient rehabilitation institutions, more seldom they continue their treatment at retirement homes with rehabilitation facilities, and even more rarely they return to their families where rehabilitation is performed at home.

Results

Independent mobility and managing without other people's help are the basic requirements for a human at an advanced age. The prevalence of proximal femur fractures exceeds 10%, of which more than 80% occur in the elderly. The treatment of choice for these fractures is surgical approach with early physical therapy.

In our survey, the hospitalization time was 15 days with a preoperative period of 5 days. The number and localization of proximal femur fracture in the elderly are presented in Table 1, and operative treatment, number and type of fracture in Table 2.

In the total of 372 femur fractures, there were 152 (41%) patients with femoral neck fracture. In 47% of cases, femoral neck fracture was treated with anatomical reduction and solid stabilization with angle blade 130-degree plate. Total hip prosthesis was used in 10%, and partial hip prosthesis in 42% of patients. Anatomical reduction and solid stabilization with cannulated screws were used in only two (1%) patients.

In the same group, there were 205 (55%) cases of intertrochanteric fractures. The treatment of stable fracture of the intertrochanteric region is highly successful. Angle plate of 130 degrees was used in 50%, DHS in 28%, and 95-degree angle plate in 22% of cases (Table 2).

In the treatment of subtrochanteric fracture, no locking nails were used but DHS and 95-degree angle plate with bone grafting.

Complications recorded during the early postoperative period included venous thrombosis in 5% of patients, and lethal pulmonary embolism in two patients. Wound infection occurred in four (1%) patients.

In this group (group 2), 204 (55%) patients were available for follow-up. Late complications included aseptic necrosis of the head of femur in 18 (5%), pseudoarthrosis of the femoral neck in seven (2%), and implant fracture in 18 (5%) patients. Three of the latter were partial hip prosthesis fracture and two were 130-degree plate fracture.

Table 1. Proximal femur fracture according to localization

Fracture site	Group 1	Group 2
	(1988/1989) n (%)	(1998/1999) n (%)
Femoral neck	62 (37)	152 (41)
Intertrochanteric	100 (57)	205 (55)
Subtrochanteric	11 (6)	15 (4)
Total	173 (100)	372 (100)

Table 2. Operative treatment of proximal femur fracture according to surgical procedure

Surgical procedure	Group 1	Group 2
	(N=173) n (%)	(N=372) n (%)
130-degree angle plate	134 (77)	158 (42.5)
Condylar plate (95 degrees)	33 (19)	61 (16.5)
DHS	-	57 (15.5)
Cannulated screw	-	2 (0.5)
Partial hip prosthesis	-	71 (19)
Total hip prosthesis	3 (2)	15 (4)
Conservative	3 (2)	8 (2)
Total	173 (100)	372 (100)

Discussion

The causes of fracture of the proximal third of the femur in the elderly are: bone fragility due to osteoporosis and osteomalacia, predisposition to falling caused by diminished control of oscillations in the vertical stance, or sudden drops in muscle tone in the ambulatory elderly. Furthermore, a wide array of other causes should be mentioned, the more common of them including vertiginous disorders, postural hypotension, cerebrovascular diseases, inadequate medication in the elderly, falls due to the surroundings (carpets, stairways, poor illumination), and relatively often alcohol consumption.

According to the information available to us, the most common causes of fracture are falls at home and outdoors as well as alcohol intoxication. The graveness of the problem of proximal femur fractures in the elderly manifests in the functional state as well as in terms of mortality rates, because the already unstable biological equilibrium of the elderly is affected and the pathologic state is additionally aggravated, and even further deteriorated by immobilization.

Constant control is required for this mixed multipathology, which most commonly includes cardiac diseases, circulatory problems, hypertension, diabetes, pulmonary functional disorders, neurologic pathology, degenerative changes of the skeletal system, and increasing psychiatric disorders. In our patients, common associated problems were atherosclerotic and hypertensive cardiomyopathy, coronary heart disease, diabetes, alcohol liver damage with delirium, generalized atherosclerosis and its sequels such as stroke with resulting hemiparesis, epilepsy, Parkinson's disease, and multiple sclerosis.

Proper treatment of femoral neck fractures depends on the patient age and degree of fracture displacement. Concomitant injuries and medical problems should also be evaluated. A nondisplaced femoral neck fracture should be fixed *in situ*. For displaced femoral neck fracture, reduction and fixation should be performed as soon as the patient is medically stable, in order to restore blood supply to the femoral head. Anatomical reduction and solid stabilization with cannulated screws are the best way to prevent osteonecrosis and non-union. In an elderly patient, hemoprosthesis replacement is a good option. Total hip replacement should be reserved for a patient who has a concomitant hip disease, or in whom fixation has failed.

The treatment of stable intertrochanteric fractures has been highly successful with the use of devices for inter-

nal fixation mentioned above. The treatment of unstable intertrochanteric-subtrochanteric fracture has been simplified by the development of newer techniques and devices which, in general, have proved highly successful. Solid fixation of the proximal fragment to the distal fragment with the use of a sliding device allows for bone impaction and restoration of medial stability, with few complications.

In the treatment of subtrochanteric fractures, the use of locking nails is technically demanding, and proximal and distal locking screws are mandatory. High-strength hip screws allow for good fixation of the fracture, and if medial comminution is present, this technique is best performed in conjunction with bone grafting.

Conclusion

The basic requirement for a human at an advanced age is independent mobility and managing without other people's help. This is substantiated by the fact that a century ago, fractures of the proximal femur were associated with a 75% mortality rate. Presently, the prevalence of fractures at this localization is higher than 10%, with more than 80% of them recorded in the elderly. Osteoporosis is, among many others, a major culprit in the etiology of these fractures.

The treatment of choice for these fractures is surgical approach because modern medicine has lowered the immediate mortality caused by these fractures to 15%. Nevertheless, it should be emphasized that mortality depends on the age of the injured. It is clear that the limits for operative intervention cannot be defined by the calendar but primarily biologically.

Physical therapy and rehabilitation are not lagging behind surgery in their importance, relevance and benefit for the final therapeutic success. Their aim is to restore basic life functions and necessary locomotion of the patient by use of crutches or walkers.

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Sažetak

LOMOVI GORNJEG OKRAJKA NATKOLJENIČNE KOSTI U STARIH OSOBA

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Lom gornjega okrajka natkoljencične kosti u starih osoba uvijek predstavlja aktualan problem. Mnogo je uzroka loma natkoljencične kosti u toj životnoj dobi, ali je u središtu zbivanja ipak osteoporozna i biomehaničko slabljenje kosti. Prema današnjim saznanjima može se ustvrditi da je opća smrtnost ove dobne skupine za 15% niža od unesrećenih koji su slomili proksimalni okrajak bedrene kosti, te su prema suvremenim znanstvenim spoznajama operacijski liječeni. U ovom su radu uspoređene dvije skupine ispitanika u razmaku od deset godina (2000./1999. i 1998./1989.). Najznačajniji je podatak da je u deset godina za 100% povećan broj hospitaliziranih zbog navedene ozljede, te je time oko 45% kapaciteta traumatološkog odjela Klinike za kirurgiju Kliničke bolnice "Sestre milosrdnice" zauzet gerijatrijskom traumatologijom. U razdoblju od dvije godine, 2000./1999., bilo je ukupno 372 ozlijeđenika s lomom u navedenoj regiji. Od toga je 21% (n=78) muškaraca i 79% (n=204) žena. Prosječna dob je bila 73 godine, i to 69 za muškarce i 79 za žene. Prosječno trajanje boravka u bolnici bilo je 15 dana, s čekanjem na operaciju u prosjeku 5 dana. Svega je 2% bolesnika liječeno konzervativnim postupkom zbog kontraindikacija za operaciju. Zabilježena je perioperacijska smrtnost od 2,5% ili devet slučajeva. Od ukupnoga broja ozlijeđenika, 152 (41%) ih je imalo lom vrata bedrene kosti, 205 (55%) pertrohanterni lom, a 15 (4%) subtrohanterni lom. Operacijsko liječenje uz odgovarajući rehabilitacijski postupak ima velike prednosti i predstavlja metodu izbora u liječenju lomova gornjega okrajka natkoljencične kosti u starih osoba.

Ključne riječi: Prijelomi natkoljencične kosti, liječenje; Prijelomi natkoljencične kosti, kirurgija; Fiksacija prijeloma; Dobni čimbenici; Stare osobe