THE BURDEN OF DISEASES ANALYSIS OF FEMORAL NECK FRACTURES WITH THE INTEGRATED APPROACH OF MEDICAL PROFESSIONALS, PUBLIC HEALTH AND PURCHASER

Doctoral (Ph.D.) thesis

ANDOR SEBESTYÉN M.D., M.B.A.

Baranya County Health Insurance Fund
Department of Public Health Medicine, University of Pécs

Head of the Doctoral School of Health Sciences:
Prof. Dr. József Bódis Ph.D., D.Sc.

Programme leader and supervisor of the Doctoral School of Health Sciences:
Prof. Dr. István Ember Ph.D., D.Sc.

Pécs 2007

1. INTRODUCTION

Fractures resulting from osteoporosis, especially those around the hip, represent a significant public health problem considering their contribution to morbidity and mortality. Their expenses impose significant financial burden to the governments even in the most developed countries.

Traumatic fractures of the femoral neck, vertebrae or wrist developed on the ground of degenerative and other pathologic alterations of the bones and joints represent a severe musculoskeletal problem among the elderly population, and today, more frequently in the middle aged population. The number of hip fractures was estimated as 1,66 million in 1990 with an estimated increase to 6,26 million by 2050. In Hungary, according to *Péntek et al (2007),* the incidence of hip fractures related to osteoporosis was 343/100 000 in 1999-2003 in the population aged 50-100.

International studies investigate the different types and components of expenses related to these fractures regarding different years and age-groups, different currencies and genders. According to *Wiktorowicz (2001),* the expenses of hip fractures will increase from 650 million Canadian dollars to 2.4 billion by 2041. *Nurmi et al (2003)* calculate the average expenses around 14 410 EUR in the first year, approximately ¼ of which derives from acute care, but the prolonged inpatient service could increase the expenses even to 35 700 EUR.

In the period following the acute care, complications relating to fracture-healing can significantly increase the expenses. Among these are avascular necrosis of the femoral neck (AVN) and the development of nonunion; the rate of their further management shows a heterogeneous picture in the related literature. Secondary operations are performed in 36 % due to AVN or nonunion according to *Karaeminogullari et al (2004),* and in 20 % due to AVN according to *Nikolopoulos et al (2003).* In the elderly population, re-operations occur in 30 % according to *Strauli et al (2001),* while *Bosch et al (2001)* found the rate of re-operations to be 18.5 %.

The high mortality rates of hip fractures among the elderly (10 % in the first 30 days according to *Goldcare (2002)* and 10-36 % in the first year according to *Zuckerman et al (1996)*) represent a severe public health problem.

The effective management of hip fractures occurring in the elderly population represents a high priority considering the age-composition of the population, the frequency of osteoporosis, altered life style and nutrition habits, certain accompanying diseases, the increase in the lifetime expected at birth, and certain anatomical and genetic features, all resulting in higher incidence of hip fractures. The treatment of femoral neck fractures can represent a challenge for the trauma surgeons, since stable fixation has to be achieved together with improving life quality by the most optimized utilization of the health insurance sources.

The reduction of the financial burden resulting from femoral neck fractures can be achieved via the reduction of fracture incidence as a result of multi-level interventions and by the reduction of the incidence of the complications. Together these could also serve public health goals by reducing mortality.

Evaluating death occurring after the primary treatment, analysing further interventions associated with fracture healing complications and their risk factors as well as monitoring the altered working ability and analysing the expenses from both the professional view and from the view of the financing institutes are essential to optimize the burden imposed on the patients, health care services and the state. The results could contribute to the development of more effective strategies during the professional and health political decision-making processes. The resolution of the revealed anomalies can reduce the burden and can improve the mortality and morbidity rates through the professional and legal regulation of the health care system.

Several studies have investigated the secondary interventions performed following the primary treatment of femoral neck fractures, their contribution to mortality, their prognostic factors and the related expenses. In Hungary, however, only a few authors investigated the significance of these secondary treatments and the above-described factors in overall, nationwide analyses. The present dissertation is aimed to fill this gap through the integration of investigations carried out in Hungary in the “Bone and Joint Decade”.

2. AIMS OF THE STUDY

The dissertation focuses on the analysis of the disease-burden related to further treatments following the primary treatment of intracapsular femoral neck fractures, representing a frequent and severe problem in the elderly population, via integrating medical professional, public health and financial approaches. Intracapsular fractures was selected of all femoral neck fractures on the basis of their high incidence and the wide range of prognostic factors that influence financing relating to the secondary management of these kind of fractures. The analysis also focused on the financial burden imposed on the National Health Insurance Fund relating to the treatment of femoral neck fractures as well as on the influencing factors of treatments representing excess expenses and those resulting in higher mortality. Specifically, the aims of the dissertations are the follows:

1. To analyse timeline characteristics and relationships of the fracture healing treatments after primary treatment of medial femur neck fracture according to most frequently used types of operation and Garden classification under 60.

2. To evaluate the correlation between complications required surgery (fracture-related treatment) and prognostic factors following internal fixation in young adults with intracapsular femoral neck fracture.

3. To investigate the mortality in timeline following primary treatment in patients over 60 with femoral neck fracture on monthly and yearly during a 5 years follow up period.

4. To evaluate the effect of different risk factors on mortality following primary treatment in patients over 60 with femoral neck fracture during the follow up (monthly, yearly, 5 year).

5. To analyse the average cost of patients under the age of 60 with medial femoral neck fracture up to 2 years follow up after the primary treatment according to the most frequently used surgical methods and Garden classification.

6. To assess the changes in the *50-100 % impaired ability to work related to femoral* neck fracture in patients with intracapsular femoral neck fracture under 60 during 3 years follow up.

7. To calculate the burden of femoral neck fracture and possibility of savings in 2007 from purchaser's point of view.

8. To underline expectations and critics regarding the performance reports (coding) of the institutions representing the basis of analyses, the ICD system and other professional considerations from the health insurance point of view.

Detailed methodology and results are given in the next chapters based on our previous publications.

3. DETAILED ANALYSIS

3.1. Two years follow up of further treatment after primary surgical treatment of patients under 60 with medial femur neck fracture

Background: Several studies have investigated the significance of complications occurring after the primary treatment of femoral neck fractures and their further management. However, the majority of these studies have enrolled only a limited number of patients, and only a few have investigated a larger population by analysing data obtained from a nationwide service system.

Objectives: The aim of the study is to analyze timeline characteristics and the relationship of the further treatments (especially the arthroplasty) and complications related to the fracture after primary treatment of medial femur neck fracture according to the most frequently used types of operation and Garden classification.

Patients and methods: Data on patients aged under 60 undergone primary surgical treatment for medial femoral neck fractures were obtained from the database of the National Health Insurance

Fund Administration and from a questionnaire carried out in all institutions enrolled. Further management associated with fracture-healing complications following the most frequent type of primary surgical treatment of femoral fractures classified according to the Garden classification system was evaluated. Specifically, the time course of prosthetic treatments (secondary arthroplasty) and their relation to different prognostic factors were analyzed.

Results: Out of the all 518 patients operated with *medial femoral neck fractures*, 17,76 % required further interventions. The rate of further interventions after primary reduction internal fixation (*screw fixation)* was 18,4 % (in 8,23 % non-prosthetic treatment (NPT), while in 10,17 % prosthetic treatments (PT) were performed). Regarding *Garden classification*, in the case of type I fractures further treatments occurred in 2,86 % (all NPT), while in cases of type IV fractures further interventions were performed in 28,84 % (the rate of NPT was 7,69 % and the rate of PT was 21,15 %). *Multiple surgical interventions* were necessary in 3,47 % of all medial femoral neck fractures, and in 19,57 % of cases with complications. These were performed in 1,43 % of Garden type I fractures and in 13,46 % following Garden IV fractures. In the investigated 2-year period, the rate of NPT interventions decreased, but the rate of PT interventions increased *(Figure 1).*

The statistical analysis revealed that regarding Garden classification, more severe fractures were associated with significantly increased risks for further interventions relating to the less severe type I fractures ($OR_{GII./GI.}$ =7,33, p:0,0125; $OR_{GIII./GI.}$=7,83, p:0,0083; $OR_{GIV./GI.}$=12,14, p:0,0024). The increased risks were even more significant when only prosthetic treatments were considered ($OR_{GII./GI.}$=8,29, p:0,0556; $OR_{GIII./GI.}$=8,94, p:0,0432; $OR_{GIV./GI.}$=19,04, p: 0,0090). Regarding the type of primary surgical treatment, the risk for any further treatment ($OR_{arthrolasty/screw\ fixation}$=0,23, p:0,0205) and for PT interventions ($OR_{arthroplasty/screw\ fixation}$=0,11, p:0,0371) was significantly increased following primary screw fixation in comparison with primary arthroplasty.

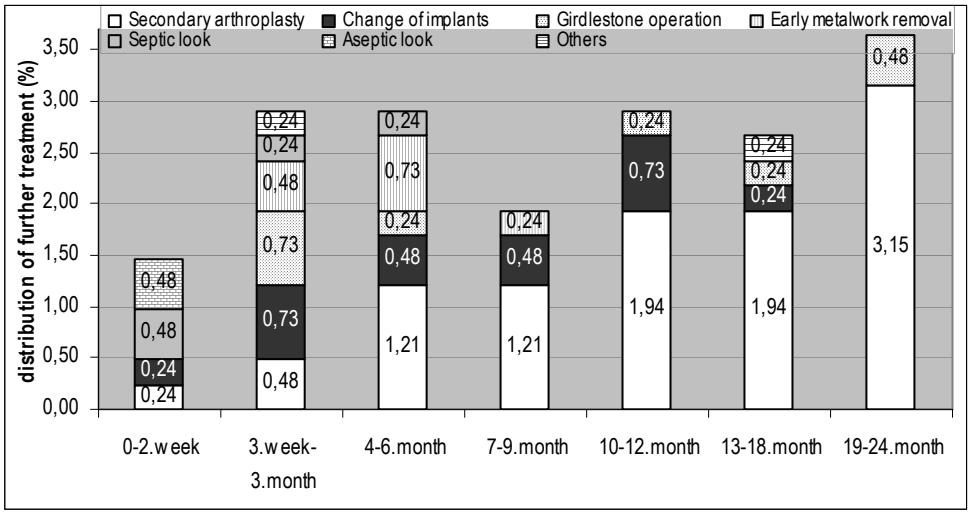

Figure 1
Distribution of further interventions (18,4 %) following primary internal fixation during the investigated 2-year period in relation to the time elapsed from the primary treatment.

Conclusion: Current protocols in the primary management of femoral neck fractures recommend primary reduction internal fixation or arthroplasty for primary treatment based on the Garden classification system. Undisplaced fractures are treated with reduction internal fixation, while in the case of displaced fractures, prosthetic treatments are considered depending on the size of the displacement and the time elapsed from the fracture. According to our analysis, the 28,84 % rate of further interventions in the case of the most severe Garden IV fractures and the 71,16 % rate of the lack of further interventions may suggest bone consolidation occuring during the investigated 2-year period. This might also indicate that the vitality and circulation of the femoral neck might remain sufficient even in the case of displaced fractrues. Our results question the protocol of mandatory prosthetic treatments following Garden IV fractrues suggesting that stable reduction internal fixation can be considered in selected cases.

The high odd ratios of displaced fractures for furhter interventions underline the importance of further evaluations regarding risk factors and the need to develop risk reducing treatments as part of the secondary management following the primary treatment of femoral neck fractures.

3.2. Correlation between risk factors and subsequent surgical management following internal fixation of intracapsular femoral neck fractures in young adults

Background: Regarding intracapsular femoral neck fractures, the main focus of research is the correlation between fracture-related complications and prognostic factors.

Objective: To evaluate the correlation between complications required surgery (fracture-related treatment) and, among others, several less extensively investigated prognostic factors (day of surgery, co-morbidities, hospital type) in a 2-year period following internal fixation in young adults with intracapsular femoral neck fracture.

Patients and methods: Retrospective analysis of femoral neck fractures occurred in Hungary in 2000, based on data obtained from the National Health Isnurance Fund Administration. The data were validated and completed by a questionnaire carried out in all 60 institutions enrolled. The effects of prognostic factors were analyzed by uni- and multivariate logistic regression in three groups: all fracture-related treatments, non-prosthetic and prosthetic treatments.

Results: Out of 413 patients, 17,92 % required further fracture-related treatment. In 7,75 % non-prosthetic, and in 10,17 % prosthetic treatment was performed. Fracture displacement (OR=2,243), weekend surgery (OR=2,347), infections (OR=3,681), central nervous system-related co-morbidities (OR=3,639) and the county hospital level of management (OR=2,356) were associated

with significantly increased risk for further surgery *(Table 1).* In the case of the latter, the wider service capacity for secondary arthroplasty represents a higher risk for further interventions.

PROGNOSTIC FACTORS	FRACTURE-RELATED TREATMENT								
	ALL			NON PROSTHETIC TREATMENT			PROSTHETIC TREATMENT		
	OR	[CI]	(p-value)	OR	[CI]	(p-value)	OR	[CI]	(p-value)
Gender (female / male)	1,026	[0,587 ; 1,794]	(0,926)	0,695	[0,307 ; 1,572]	(0,383)	1,363	[0,672 ; 2,765]	(0,390)
Age (≤ 50 years / > 50 years)	0,882	[0,495 ; 1,572]	(0,672)	0,558	[0,249 ; 1,250]	(0,156)	1,358	[0,630 ; 2,928]	(0,433)
Fracture displacement (Garden III-IV / G I-II)	**2,215**	**[1,216 ; 4,034]**	**(0,009)**	1,809	[0,773 ; 4,237]	(0,171)	**2,243**	**[1,036 ; 4,858]**	**(0,040)**
Day of surgery (weekdays/weekends))	1,705	[0,942 ; 3,085]	(0,077)	**2,347**	**[1,049 ; 5,248]**	**(0,037)**	1,135	[0,525 ; 2,452]	(0,746)
Hospital type (capital / national and university)	1,120	[0,398 ; 3,154]	(0,829)	1,274	[0,310 ; 5,238]	(0,736)	1,052	[0,256 ; 4,311]	(0,943)
Hospital type (county / national and university)	**2,356**	**[0,997 ; 5,568]**	**(0,050)**	1,484	[0,445 ; 4,943]	(0,520)	2,968	[0,945 ; 9,315]	(0,062)
Hospital type (city / national and university)	1,159	[0,462 ; 2,911]	(0,752)	1,315	[0,377 ; 4,576]	(0,666)	1,082	[0,305 ; 3,832]	(0,902)
Surgical delay (0-12 h / >12 h)	0,909	[0,529 ; 1,562]	(0,730)	0,863	[0,394 ; 1,887]	(0,712)	0,960	[0,488 ; 1,888]	(0,906)
Nervous system-related diseases (yes / no)	1,912	[0,899 ; 4,067]	(0,092)	**3,639**	**[1,421 ; 9,318]**	**(0,007)**	0,817	[0,268 ; 2,491]	(0,723)
Diabetes mellitus (yes / no)	0,585	[0,164 ; 2,079]	(0,407)	1,308	[0,274 ; 6,250]	(0,736)	0,273	[0,034 ; 2,149]	(0,217)
General infection (yes / no)	**3,449**	**[1,386 ; 8,584]**	**(0,007)**	**3,681**	**[1,172 ; 11,55]**	**(0,025)**	2,295	[0,697 ; 7,556]	(0,171)
Hypertension (yes / no)	0,725	[0,340 ; 1,546]	(0,406)	0,794	[0,247 ; 2,548]	(0,698)	0,747	[0,298 ; 1,867]	(0,532)
Ischemic heart disease (yes / no)	2,123	[0,782 ; 5,762]	(0,139)	2,116	[0,532 ; 8,415]	(0,286)	1,887	[0,549 ; 6,479]	(0,313)
Alcohol related mental diseases (yes / no)	1,216	[0,606 ; 2,437]	(0,581)	1,134	[0,432 ; 2,977]	(0,797)	1,224	[0,503 ; 2,981]	(0,655)

(OR: Odds ratio, CI: 95 % confidence interval, p: significance of the statistical test)

Table 1

The relation of fracture-related treatment, NPT and PT to particular prognostic factors in multivariate logistic regression models

Conclusions: To reduce the influence of risk factors, standardization of the substantive traumatologic and orthopedic professional guidelines, as well as the introduction of common orthopedic-trauma patient care (British model) are suggested. To achieve high-quality standardized patient management, personal and material conditions are required to be accessible every day of the week. In the presence of co-morbidities, reduction of their harmful effects should be a major consideration by focusing on the patient in the perioperative periods.

3.3. Evaluation the correlation between risk factors and mortality in the elderly patient with femoral neck fracture during 5 years follow up

Introduction: Hip fractures are associated with increased mortality in the elderly. There are only few study based on large patient number covering a nationwide health care system.

Objective: The aim of this study was to investigate the mortality following primary treatment in patients over 60 with acute, monotraumatic femoral neck fracture on monthly and annual base during a 5 years follow up period; and to evaluate the effect of different risk factors on mortality during the follow up.

Patients and methods: Data were derived from the nationwide database of the National Health Insurance Fund Administration. The evaluation includes patients with femoral neck fracture

discharged from inpatient care institutions in 2000 following a primary surgical treatment. We calculated weekly, monthly and annual mortality rates, and its monthly and annual trends according to risk factors. Logistic and Cox regression analysis was performed to evaluate the correlation between risk factors and mortality.

Results: 3.783 patients were involved into the study with a mean age 77,97 years (SD 8,52). The mortality rates were 1,71 % (during the first week), 8,99 % (30 days), 30,74 % (first year) and 61,88 % (5 years). Mortality showed a declining trend up to the 5th month, and is stagnant after the first year. Risk factor analysis showed that higher risk of mortality is associated with male sex and higher age group up to 5 years, co-morbidities up to 4 years, lateral type femoral neck fracture and 12 hours delay of primary treatment up to 2 years, early local complications up to 1 year and surgical treatment during week-end up to 1 month. Surgical treatment delivered in national health institutes and university clinics resulted in a lower mortality risk up to 1 year. *(Table 2-3)*

Conclusions: In order to reduce mortality during the management of hip fractures, we emphasize the importance of within 12 hours delay of treatment, appropriate selection of methods corresponding fracture type, providing the same conditions for primary treatment during all the day of the week, to organize the treatment to special centres, appropriate acute care and follow up corresponding to the general health status and co-morbidities of patients.

PROGNOSTIC FACTORS		HAZARD RATIO [95 % CI] (P)	
		UNIVARIATE COX REGRESSION	MULTIVARIATE COX REGRESSION
GENDER	(female / male)	0,890 [0,813 ; 0,974] **(0,012)**	0,848 [0,773 ; 0,931] **(<0,001)**
AGE	(70-79 y / 60-69 y) (80-89 y / 60-69 y) (90 y+ / 60-69 y)	1,139 [0,989 ; 1,312] **(0,069)** 1,192 [1,035 ; 1,372] **(0,014)** 1,655 [1,399 ; 1,957] **(<0,001)**	1,188 [1,021 ; 1,370] **(0,018)** 1,269 [1,098 ; 1,466] **(0,001)** 1,731 [1,458 ; 2,055] **(<0,001)**
CO-MORBIDITIES	(yes / no)	1,203 [1,011 ; 1,432] **(0,037)**	1,201 [1,008 ; 1,430] **(0,041)**
FRACTURE DISPLACEMENT	(medial GI-II. / lateral) (medial GIII-IV. / lateral)	0,860 [0,742 ; 0,996] **(0,045)** 0,887 [0,784 ; 1,003] **(0,055)**	0,836 [0,721 ; 0,970] **(0,018)** 0,888 [0,784 ; 1,007] **(0,064)**
TYPE OF OPERATION	(osteosynthesis / arthroplasty)	1,152 [1,015 ; 1,308] **(0,029)**	1,162 [1,010 ; 1,336] **(0,036)**
HOSPITAL TYPE	(county / capitol) (national and university / capitol) (city / capitol)	0,912 [0,816 ; 1,019] (0,106) 0,770 [0,665 ; 0,892] **(<0,001)** 0,884 [0,789 ; 0,990] **(0,034)**	0,957 [0,853 ; 1,074] (0,454) 0,790 [0,680 ; 0,918] **(0,002)** 0,913 [0,813 ; 1,026] (0,125)
EARLY LOCAL COMPLICATION	(yes / no)	1,133 [0,863 ; 1,488] (0,369)	1,181 [0,898 ; 1,553] (0,233)
DAY OF SURGERY	(weekends / weekdays)	1,058 [0,958 ; 1,169] (0,263)	1,050 [0,950 ; 1,161] (0,336)
SURGICAL DELAY	(6-12 h / 0-6 h) (12-24 h / 0-6 h) (24 h + / 0-6 h)	1,039 [0,914 ; 1,182] (0,554) 1,105 [0,973 ; 1,256] (0,125) 1,109 [0,999 ; 1,232] **(0,052)**	1,027 [0,902 ; 1,170] (0,683) 1,121 [0,985 ; 1,275] **(0,083)** 1,169 [1,047 ; 1,305] **(0,006)**

Table 2
The relation of 5 year mortality to particular prognostic factors in cox regression models

PROGNOSTIC FACTORS		UNIVARIATE LOGISTIC REGRESSION					Multivarite logistic regression				
		1. y	2. y	3. y	4. y	5. y	1. y	2. y	3. y	4. y	5. y
GENDER	(female / male)	0,671S	0,691S	0,705S	0,759BS	0,821	0,570S	0,594S	0,588S	0,608S	0,662S
AGE	(70-79 y / 60-69 y)	1,933S	1,832S	2,157S	1,799S	1,540S	2,036S	1,868S	2,235S	1,831S	1,574S
	(80-89 y / 60-69 y)	3,215S	3,001S	3,379S	2,725S	3,538S	3,568S	3,148S	3,589S	2,871S	3,704S
	(90 y+ / 60-69 y)	7,289S	3,867S	5,621S	6,965S	4,678S	7,936S	4,021S	6,047S	8,102S	5,068S
CO-MORBIDITIES	(yes / no)	2,330S	1,919S	1,897S	2,711S	1,597BS	1,959S	1,704S	1,685S	2,641S	1,391
FRACTURE DISPLACEMENT	(medial G I-II. / lateral)	0,562S	0,642S	0,745	0,737	0,631	0,570S	0,678BS	0,766	0,731	0,625
	(medial G III-IV./ lateral)	0,780S	0,662S	0,909	0,894	1,051	0,880	0,698S	0,976	0,910	1,106
TYPE OF OPERATION	(osteosynthesis / arthroplasty)	1,551S	1,100	1,160	1,026	1,153	1,982S	1,114	1,231	1,069	1,603BS
HOSPITAL TYPE	(county / capitol)	0,935	0,969	1,015	1,314	1,165	1,138	1,085	1,176	1,595S	1,441BS
	(national and university / capitol)	0,706S	1,017	0,940	1,263	1,300	0,779BS	1,033	0,974	1,421	1,444
	(city / capitol)	0,915	1,023	1,297	1,617S	1,167	1,029	1,081	1,462S	1,991S	1,400
EARLY LOCAL COMPLICATION	(yes / no)	1,540BS	0,38	0,852	1,064	0,831	1,905S	0,391	0,891	1,008	0,845
DAY OF SURGERY	(weekends / weekdays)	0,997	0,972	0,875	0,887	0,847	0,987	1,013	0,909	0,935	0,871
SURGICAL DELAY	(6-12 h / 0-6 h)	1,068	1,204	1,052	0,900	1,014	1,040	1,157	1,055	0,886	0,971
	(12-24 h / 0-6 h)	1,336S	1,634S	1,391BS	1,032	1,308	1,287S	1,539S	1,331	0,904	1,244
	(24 h + / 0-6 h)	1,487S	1,286BS	1,173	1,097	1,235	1,786S	1,324BS	1,289	1,121	1,439BS

Significant (S): P<0.05; Borderline significance (BS): 0.05<P<0.1;

Table 3
The relation of yearly mortality to particular prognostic factors in logistic regression models on a 5 year follow up

3.4. The analysis of health insurance costs of patients under 60 with medial femoral neck fracture treated primarily with screw fixation or hip replacement

Objective: The aim of the study is to analyse the cost of patients under the age of 60 with medial femoral neck fracture up to 2 years follow up after the primary treatment including cost of acute and chronic inpatient care, outpatient care, sickness pay and changes in ability to work according to the most frequently used surgical methods and Garden classification.

Patients and methods: Patients were identified from the financial database of the National Health Insurance Fund Administration and a questionnaire was used for further analysis. The costs of patients were analysed in three groups I) all patients, (II.) patients with further treatment because of complications, and (III.) patients cured by one primary treatment.

Results: Altogether 518 patients were included into the study: 413 (79,7 %) with primary screw fixation and 48 (9,3 %) with hip replacement. The average cost for all patients (I) for the 2 years follow up was 582.181 Hungarian Forint (HUF) with screw fixation and 545.300 HUF with hip replacement. The average cost per patients in the group with one primary surgical treatment (III) was (N=337, 81,6 %) 441.466 HUF with screw fixation and (N=44, 91,6 %) 561.027 HUF with hip

replacement. The average cost per patients in the subgroup with further hospitalization because of complications (II) was (N=76, 18,4 %) 1.005.578 HUF with screw fixation and (N=4, 8,4 %) 775.640 HUF with hip replacement. The costs according to Garden classification (I-IV.) were as follows: patients without complications from 436.681 HUF to 659.160 HUF and patients with complications from 628.323 HUF to 1.192.564 HUF. *(Table 4)*

Conclusion: The results suggest that patients (N=76, 18,4 %) having displaced fractures with screw fixation receiving further treatment should be treated – knowing the vitality of femoral head – with stable osteosynthesis or hip replacement in order to reduce further reoperations and finally, health insurance expenditures and patients' burden.

PRIMARY SURGICAL METHODS	I. ALL PATIENT	II. PATIENTS WITH FURTHER TREATMENT BECAUSE OF COMPLICATIONS	III. PATIENTS CURED BY ONE PRIMARY TREATMENT	INCREASE OF COSTS (II. / III.)
	HUF/ PATIENT	HUF / PATIENT	HUF / PATIENT	
ALL	546.111	968.942	454.764	2,2
Arthroplasty	582.181	775.640	561.027	1,4
Screw fixation	545.300	1.005.578	441.466	2,3
Garden I.	436.981	628.323	431.354	1,5
Garden II.	561.002	966.237	450.525	2,2
Garden III.	546.991	972.837	441.750	2,2
Garden IV.	659.160	1.192.564	442.771	2,7

Table 4
The average insurer's cost per patient in all patients, patients with and without complications

3.5. Changes in the impaired ability to work in patients under 60 with medial femoral neck fracture during 3 years follow up

Objective: The aim of the study is to analyze the 50-100 % impaired ability to work related to medial fracture of femoral neck of patients in working age.

Patients and methods: Data derive from the database of the National Health Insurance Fund Administration and National Institute for Medical Expertise and based on the ICD-10 code S7200 (femoral neck fracture). The ratio of impaired ability to work were calculated in patient with medial femoral neck fracture under 60 regarding the surgical methods, the progressivity level of the primary treatment, rehabilitation care, age group and residence of patients, and the possible complications on a 3 years follow up.

Results: 518 patients met the selection criteria and 23,7 % of them (N=123) had impaired ability to work. The proportion of patients with impaired ability to work was 41,3 % in patients with further treatment and 20 % in patients with one definitive treatment. 16,3 % of disabled patients received rehabilitation treatment. The proportion of patients with impaired ability to work according to the most frequently used methods of primary surgery were 27,1 % in arthroplasty, 23,7 % in screw fixation *(Table 5)* and 20,6 % in DHS. The proportion of disabled patients increased in higher age

groups. The lowest rate (13,2 %) of impaired working ability occurred in patients treated in Budapest. We found the highest rate of impaired ability to work according to the residence of patients in the North-Hungarian (29,8 %) and Souther-Greatplane (31,6 %) regions.

Conclusion: In addition we found higher impaired ability to work ratio in patients with complications receiving further treatment and in arthroplasty. According to residence of patients the rate of impaired working ability were the highest in the eastern parts of Hungary. We emphasize the importance of acut management of femoral neck fracture to reduce the complications. In order to reduce the impaired ability to work, the sick-pay period should be used more efficiently by rehabilitation care. The frequency of impaired ability to work is not only a health related problem but also it is an effect of social and economic processes.

SURGICAL METHOD	TOTAL NUMBER OF CASES	PROPORTION OF PATIENTS WITH 50-100 % IMPAIRED ABILITY TO WORK
Screw fixation	413	23,7 %
Patients with further treatment	76	44,7 %
Secundary arthroplasty	42	50,0 %
Non prosthesis treatment	34	38,2 %
Patients cured by one primary treatment	337	19,0 %

Table 5
The ratio of impaired ability to work according to further treatment following the screw fixation with the highest case number

3.6. Modelling of burden of femoral neck fracture in 2007 from purchaser's point of view

This chapter provides a model of the treatment cost of femoral neck fracture and financial burden of the annual fracture cases at 2007 financial level from health insurance point of view. Cases healing following primary treatment (without complications) and cases with complications are examined separately. The costs of most common complications with large surgical operation are calculated.

The costs of the treatment of femoral neck fractures are modelled according to the actually OEP reimbursed types of care including acute inpatient care, chronic inpatient care, outpatient care, pharmaceuticals and medical devices, home care (nursing), cost of travelling or transport and the disability to work. The financial burden has been estimated by using data from international literature and Hungarian studies (number of fractures, mortality, ratio of further treatment, etc.) which are extrapolated for the average health insurance treatment cost of one patient.

The cost of patients in active age-groups *cured by primary treatment* can vary in a range of 936.254-1.387.711 HUF depending on cost level of individual care and utilization, while the cost of patients in retired age-groups (pensioners) can vary in a range 606.254 - 1.057.711 HUF *(Table 6).* The cost of patients with complication (primary treatment and complication) in active age-groups can reach.712.720 – 2.950.278 HUF depending on cost level of individual care and utilization,

while the cost of patients in retired age-groups (pensioners) can reach 1.052.720 – 2.290.278 HUF *(Table 7).* According to our model calculations, the cost of primary treatment of femoral neck fractures and essential further treatment represents an annual burden of 4.168.624.290 – 5.918.284.659 HUF for the health insurance system *(Table 8).*

TYPES OF CARE	PATIENTS CURED BY ONE PRIMARY TREATMENT		TREATMENT OF COMPLICATIONS	
	OS	AP	OS	AP
Acute inpatient care	513.161 Ft *	456.968 - 724.861 Ft	297.180 – 876.266 Ft	297.180 – 899.364 Ft
Chronic inpatient care	123.480 – 166.950 Ft		123.480 – 166.950 Ft	
Outpatient care	12.534 Ft		12.534 Ft	
Medicaments	12.282 - 24.906 Ft		12.282 - 24.906 Ft	
Medical devices	990-14.550 Ft		990-14.903 Ft	
Sickness pay	407.000 Ft*	330.000 Ft	330.000 Ft	
Patient transportation	0 - 71.910 Ft		0 - 71.910 Ft	
Home nursing	0 - 42.000 Ft		0 - 42.000 Ft	
TOTAL HEALTH INSURANCE EXPENDITURES				
- WITH SICK PAY	**1.069.447-1.253.011 Ft**	**936.254-1.387.711 Ft**	**776.466 -1.539.469 Ft**	**776.466 -1.562.567 Ft**
- WITHOUT SICK PAY	**662.447-846.011 Ft**	**606.254 -1.057.711 Ft**	**446.466-1.209.469 Ft**	**446.466-1.232.567 Ft**

* Also contains the expenses of acute inpatient service and following recovery period associated with metalwork removement after bone remodellation

Table 6

Expenses of the insurer during the primary treatment of fractures and the treatment of complications according to the different types of care

TYPES OF CARE	OS	AP
Acute inpatient care	810.341 - 1.389.427 Ft*	754.148 - 1.624.225 Ft
Chronic inpatient care	246.960 - 333.900 Ft	
Outpatient care	25.068 Ft	
Medicaments	24.564 – 49.812 Ft	
Medical devices	1.980 - 29.453 Ft	
Sickness pay	737.000 Ft*	660.000 Ft
Patient transportation	0 - 143.820 Ft	
Home nursing	0 - 84.000 Ft	
TOTAL HEALTH INSURANCE EXPENDITURES - WITH SICK PAY	**1.845.913 – 2.792.480 Ft**	**1.712.720 – 2.950.278 Ft**
- WITHOUT SICK PAY	**1.108.913 – 2.055.480 Ft**	**1.052.720 – 2.290.278 Ft**

* Also contains the expenses of acute inpatient service and following recovery period associated with metalwork removement

Table 7

The total expenses of the insurer per patient in the case of complications according to the type of care

TYPES OF PRIMARY CARE	HEALTH INSURANCE EXPENDITURES		∑ HEALTH INSURANCE EXPENDITURES
	OSTEOSYNTHESIS	ARTHROPLASTY	
Acute inpatient care	2.539.120.628 Ft	322.619.408 - 511.751.866 Ft	2.861.740.036 – 3.050.872.494 Ft
Chronic inpatient care	610.979.040 – 826.068.600 Ft	87.176.880 - 117.866.700 Ft	698.155.920 – 943.935.300 Ft
Outpatient care	62.018.232 Ft	8.849.004 Ft	70.867.236 Ft
Medicaments	60.771.336 – 123.234.888 Ft	8.671.092 –17.583.636 Ft	69.442.428 – 140.818.524 Ft
Medical devices	4.898.520 – 71.993.400 Ft	698.940 – 10.272.300 Ft	5.597.460 - 82.265.700 Ft
Sickness pay	128.612.000 Ft	10.560.000 Ft	139.172.000 – 139.172.000 Ft
Patient transportation	0 – 355.810.680 Ft	0 – 50.768.460 Ft	0 – 406.579.140 Ft
Home nursing	0 – 207.816.000 Ft	0 – 29.652.000 Ft	0 – 237.468.000 Ft
TOTAL	**3.406.399.756–4.314.674.428 Ft**	**438.575.324 – 757.303.966 Ft**	**3.844.975.080–5.071.978.394 Ft**

Table 8
The modeled annual financial burden of the primary management of femoral neck fractures according to the type of care and in cases of osteosynthesis and arthroplasty

Among the possible savings, the effect of risk factors leading to multiple risks regarding further treatments should be investigated. It can be emphasized the role of *week-end treatments* with significant practical importance, which can realize a savings of 2.527.726 – 137.221.059 HUF with appropriate continuous management. In case of the presence of *co-morbidities*, the further treatments can lead to an extra expenditure of 93.233.802 – 243.545.393 compared to cases without co-morbidities, where savings can be realized by continuous treatment and prevention of co-morbidities. The cost of further treatment of patients with displaced fracture can cause an extra expenditure of 77.063.958 – 202.433.447 HUF compared with cases with un-displaced fracture, which can be reduced by providing appropriate diagnostic (osteoscopia) and surgical background.
By reducing the effect of risk factors mentioned earlier, the whole financial burden can be reduced by 2-4 %.

3.7. Anomalies of performance reports and ICD codes

Finally, the need for reducing the anomalies of the performance reports codes of the health care services has to be underlined, considering that this coding system provides a basis for any further analysis. This could be achieved by using codes that reflect the actually financed service. Regarding the quality of data used in the current analysis, it has to be noted that the validity of data reported to the NHIF by the service institutions questions the validity of any further analysis based on these data. However, better, more organized and nation-wide database is not available for this type of analyses and, in the case of the present study, this database was supported, controlled and completed by a questionnaire survey carried out in the institutions enrolled.

The ICD code S7200, the only way to document femoral fractures, is not suitable for separating any traumatologic information. The code T84 includes several complications together in

the form of groups, precluding thereby the differentiated evaluation and follow up of the problems. The multi-level extension of these codes could support the nationwide professional analyses.

4. NOVEL FINDINGS AND PRACTICAL APPLICATION

The following results can be summarized for furhter utilization based on the several year long analysis of expenses imposed on the Hungarian health care system relating to further management following the primary treatment of femoral neck fractures of the Hungarian population as well as according to the evaluation of mortality, risk factors and altered working ability associated with further interventions:

1. We have proved the significant risk increase for further interventions following the primary treatment of femoral neck fractures along the Garden types of fractures and regarding reduction internal fixation.

2. With a 2 year follow up period, we have proved that reduction internal fixation can be an option for the treatment of the high risk displaced (Garden IV) intracapsular fractures, considering the high proportion (70 %) of cases that did not require further interventions suggesting bone remodellation based on the sufficient cirulation of the femoral neck.

3. We have proved that fracture displacement, weekend surgery, general infectious and neurological comorbodities and the county hospital level of treatment represent a significantly increased risk for further interventions.

4. We have determined the weekly, monthly and annual mortality rates as well as the most critical period associated with femoral neck fractures.

5. We have evaluated the *risk factors of mortality in monthly, yearly and 5 year analyses* using logistic regression and Cox regression models.

6. We have *compared the expenses of alternative surgical methods* and evaluated *the expenses related to the treatment of different types of fractures*. We have determined the average per capita expenses of the insurer in cases of all fractures and complications regarding both internal fixation and secondary arthroplasty. We have proved the multiple cost extending effects along the Garden classification.

7. We have revealed the increasing rate of impaired working ability in relation to further interventions, especially to secondary arthroplasties. Primary surgical treatment determines impaired working ability.

8. *We have determined the financial burden of femoral neck fractures and developed a model for the potentials of saving.*

This is the first dissertation from the National Health Insurance Fund Administration that evaluated the financial burden and relations of femoral neck fractures integrating medical professional, public health and finacing approaches and published these evaluations in professional journals.

Hopefully, the proved results will provide effective basis in the future for professional and health-related political decisions that are aimed to reduce the social burden of hip fractures, and will also contribute to the most effective allocation of the limited financial sources by ensuring equal chances to the access to high level services.

ACKNOWLEDGEMENTS

I would like to sincerely thank to,

István Ember professor (University of Pécs, Faculty of Medicine, Department of Public Health Medicine) for supervising this thesis;

József Nyárády professor (University of Pécs, Faculty of Medicine, Department of Traumatology and Hand Surgery) for the cooperation in scientific research in the past 10 years;

The directors generals of the National Health Insurance Fund Administration (Országos Egészségbiztosítási Pénztár, OEP) (***Zsolt Lampé, Ferenc Oberfrank, Zsuzsanna Matejka, József Kiss, Zoltán Major, Tamás Székely***) for their personal support in addition to my official duties;

Csaba Dózsa former deputy secretary of state for their proffesional commitment to my research topic;

József Bódis professor (University of Pécs, Faculty of Health Sciences, Doctoral School of Health Sciences) in his capacity as the leader of Doctoral School for facilitating the defense of thesis based on burden of diseases analysis in *„Bon and Joint Decade"*;

Imre Boncz (University of Pécs, Faculty of Health Sciences, Department of Health-Economics, Policy & Management) for the proffessional cooperation;

János Sándor (University of Pécs, Faculty of Health Sciences, Institut of Public Health) for the proffessional cooperation;

Lajos Károlyi director and ***for my colleagues*** (Baranya County Health Insurance Fund Administration) for their cooperation;

My family, my parents, my wife ***Krisztina****, my girl* ***Lilla*** *and my son* ***Gergő*** *for their understanding and support.*