Clin Orthop Relat Res (2008) 466:2827–2832
DOI 10.1007/s11999-008-0285-5

ORIGINAL ARTICLE

Is a Sliding Hip Screw or IM Nail the Preferred Implant for Intertrochanteric Fracture Fixation?

Brian Aros MD, MS, Anna N. A. Tosteson ScD, Daniel J. Gottlieb MS, Kenneth J. Koval MD

Received: 7 April 2008 / Accepted: 22 April 2008 / Published online: 9 May 2008

Abstract This study was performed to determine whether patients who sustain an intertrochanteric fracture have better outcomes when stabilized using a sliding hip screw or an intramedullary nail. A 20% sample of Part A and B entitled Medicare beneficiaries 65 years or older was used to generate a cohort of patients who sustained intertrochanteric femur fractures between 1999 and 2001. Two fracture implant groups, intramedullary nail and sliding hip screw, were identified using Current Procedural Terminology and International Classification of Diseases, 9th Revision codes. The cohort consisted of 43,659 patients. Patients treated with an intramedullary nail had higher rates of revision surgery during the first year than those treated with a sliding hip screw (7.2% intramedullary nail versus 5.5% sliding hip screw). Mortality rates at 30 days (14.2% intramedullary nail versus 15.8% sliding hip screw) and 1 year (30.7% intramedullary nail versus 32.5% sliding hip screw) were similar. Adjusted secondary outcome measures showed significant increases in the intramedullary nail group relative to the sliding hip screw group for index hospital length of stay, days of rehabilitation services in the first 6 months after discharge, and total expenditures for doctor and hospital services.

Level of Evidence: Level III, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

One or more of the authors (DG, AT) have received funding from National Institutes of Health grants AG12262 and AR048094, US Public Health Service.

B. Aros, A. N. A. Tosteson, K. J. Koval
Multidisciplinary Clinical Research Center in Musculoskeletal Diseases, Lebanon, NH, USA

B. Aros, K. J. Koval (✉)
Department of Orthopaedics, Dartmouth Medical School, 1 Medical Center Drive, Lebanon, NH, USA
e-mail: kjkmd@yahoo.com

A. N. A. Tosteson, D. J. Gottlieb
The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, NH, USA

A. N. A. Tosteson
Department of Medicine, Dartmouth Medical School, Lebanon, NH, USA

A. N. A. Tosteson
Department of Community and Family Medicine, Dartmouth Medical School, Lebanon, NH, USA

Introduction

In the United States, the annual incidence of hip fractures is approximately 296,000 [9]. Approximately 50% of these fractures are extracapsular and are referred to as intertrochanteric or pertrochanteric fractures. Historically, a sliding hip screw (SHS) has been the preferred implant to stabilize these fractures [5, 13, 18, 21, 24, 25, 35]. However, intramedullary hip screw devices have gained popularity for stabilizing this fracture type [2, 4, 7, 8, 10, 12, 16, 17, 29, 31, 32].

Intramedullary implants have mechanical and theoretical clinical advantages in comparison to a SHS [24]. Owing to its more medial placement than a SHS side plate, the intramedullary nail (IMN) is closer to the mechanical axis of the lower extremity which decreases the bending moments on the implant. Potentially, the IMN can be inserted percutaneously with lower blood loss and less periosteal disruption than a SHS. However, Parker and Handoll evaluated studies comparing intramedullary hip screws and SHS; they concluded that given the increased risk of operative and later fracture of the femur and increased reoperation rate associated with IM hip screws, SHS are superior for treating intertrochanteric fractures [33].

Many of the published studies comparing SHS and IMN for stabilization of intertrochanteric fractures have involved a small number of patients and looked at a limited number of outcomes such as mortality and need for revision surgery [2, 4, 7, 8, 10, 12, 16, 17, 29, 31, 32]. Our study, using a large cohort of Medicare beneficiaries, was performed to determine whether patients who sustain an intertrochanteric fracture have better outcomes when stabilized with a SHS or an IMN. We compared 1-year revision surgery rates, mortality, length of hospital stay, number of days using rehabilitation services, and costs associated with both implants.

Materials and Methods

We used a 20% sample of Medicare claims (Part A and Part B) submitted by hospitals and physicians between 1999 and 2001 to identify a cohort of patients who had sustained intertrochanteric femur fractures. This 20% random sample was provided by the Center for Medicare and Medicaid Services (CMS) and was used in a previous study [23]. We identified 43,659 intertrochanteric femur fractures. The International Classification of Diseases, 9th Revision (ICD-9) code 820.2 listed as the primary diagnosis and the Current Procedural Terminology (CPT) codes 27244 and 27245 were used to identify two fracture groups defined by the implant chosen for fracture stabilization, an IMN or a SHS. Patients were excluded if they were an HMO participant, sustained a fracture secondary to cancer or major trauma (based on diagnosis codes found on the MEDPAR and relevant Part B claims at the time of index hospitalization), or had sustained a hip fracture during the previous calendar year. If a patient had more than one hip fracture during the study period, the first fracture was used in the analysis. Patients with conflicting ICD-9 diagnoses not specific for the intertrochanteric region (eg, subtrochanteric, femoral neck fracture) also were excluded. An SHS was used to stabilize 40,828 (94%) fractures and an IMN was used in 2831 (6%) fractures.

Demographic characteristics that were recorded included patient age (divided into five categories: 65–69, 70–74, 75–79, 80–84, 85 years or older), gender, race (black, not black), Medicaid status at the time of fracture (yes/no), disability as reason for Medicare status (yes/no), and hospital location (characterized in three groups based on rural-urban commuting codes [19]: urban, large town/suburban, small town/isolated). Hospital hip fracture volume was stratified on three levels that approximated terciles: low (less than 250 cases per year), middle (250–630 cases per year), or high (more than 630 cases per year) to adjust for volume-outcome effects. The demographics of the two implant groups were similar (Table 1). Patients in both cohorts were predominantly white, female, and older than 80 years. Chronic illness burdens before the hip fractures were similar for the two groups as per comparison of the number of comorbidities.

We controlled for medical comorbidities using the Iezzoni comorbidity index, an accepted approach to comorbidity adjustment with administrative databases [20], using inpatient claims at the time of the index hospital admission and inpatient and outpatient claims during the 6 months before the index hospitalization. Diagnoses derived from Part B (physician services) claims were restricted to those defined as evaluation and management or procedures. Comorbidities were summed into the following categories: 0, 1, 2, or 3+ for analysis.

We used the denominator file to determine mortality at 30 days and 1 year after hip fracture. MEDPAR records were used to determine the length of hospital stay for the initial hospitalization and the 6-month period starting with the index admission. CPT codes (27090, 27236, 27130, 20680, 27132) were used to identify patients who required revision hip surgery secondary to a complication with fracture fixation within 1 year of the index procedure.

MEDPAR skilled nursing facility claims, Part B, and Home Health files were used to determine the total number of days using rehabilitation services for the first 6 months after hospital discharge. These included days spent in a skilled nursing facility, days with claims for home health or physical therapy, and comprehensive outpatient rehabilitation facility visits. Days in which patients had more than one type of therapy claim were not double-counted.

Total expenditures were calculated using standardized costs to allow comparisons free of payment differences resulting from region or teaching status of the hospitals; these costs included diagnosis-related group (DRG) weights for acute hospital admissions and total relative value units (RVU) for all Part B (physician supplier) bills. We evaluated the period from index admission to 1 year after injury (including the cost of the index hospitalization and procedure). Values were expressed in US dollars for 2000.

We used summary statistics (means, proportions) to describe the demographic profiles for the patients stabilized using either an IMN or SHS defined by ICD-9 and CPT codes. Logistic regression was used to predict the odds of binary outcomes (eg, death, revision surgery) and analysis of variance for continuous outcomes (costs, length of hospital stay, use of rehabilitation services). All models were adjusted (adjusted odds ration or AOR) for patient age, gender, race, RUCA categories, hospital fracture

Table 1. General characteristics of the cohort

Characteristic	Intramedullary nail (n = 2831)	Sliding hip screw (n = 40,828)	Overall (n = 43,659)
Gender			
Male (number/%)	657 (23.2%)	8930 (21.9%)	9587
Female	2174 (76.8%)	31,898 (78.1%)	34,072
Age			
65–69 years	130 (4.6%)	1485 (3.6%)	1615
70–74 years	248 (8.8%)	3369 (8.3%)	3617
75–79 years	425 (15.0%)	6388 (15.7%)	6813
80–84 years	9566 (23.4%)	663 (23.4%)	10,229
85–89 years	717 (25.3%)	10,792 (26.4%)	11,509
≥ 90 years	648 (22.9%)	9228 (22.6%)	9876
Mean (years)	83.6	83.8	
Race			
White	2651 (93.6%)	38,468 (94.2%)	41,119
Nonwhite	180 (6.4%)	2360 (5.8%)	2540
Nature of region			
Urban*	1826 (64.9%)	23,414 (58.1%)	25,240
Large town*	566 (20.1%)	9594 (23.8%)	10,160
Small town/isolated*	420 (18.1%)	7313 (14.9%)	7733
Hospital hip fracture volume			
< 250 cases*	628 (22.2%)	9759 (23.9%)	10,387
250–630 cases*	1446 (50.0%)	21,018 (51.5%)	22,464
> 630 cases*	757 (26.8%)	10,051 (24.6%)	43,659
Reason for medicare eligibility			
Medicaid	552 (19.5%)	7686 (18.8%)	8238
Disabled (reason for Medicare eligibility)	188 (6.6%)	2628 (6.4%)	2816
Number of Iezzoni comorbidities			
0	1343 (47.4%)	19,270 (47.2%)	20,613
1	868 (30.7%)	12,740 (31.2%)	13,608
2	402 (14.2%)	5779 (14.2%)	6181
3+	218 (7.7%)	3039 (7.4%)	3257

* Statistical tests for univariate difference based on Mantel-Hanzel chi square with $p < .05$. Grouped variables (eg, age) were evaluated across all strata at once to test for any difference between IMN and SHS populations.

volume, Medicaid status, disability status, and number of comorbidities.

Results

Similar 30-day and 1-year mortality rates were found between patients treated with both implants (Table 2). The 30-day mortality rates for the IMN and SHS groups were 14.2% and 15.8%, respectively (AOR, 0.99; 95% confidence interval [CI], 0.89–1.11). One-year mortality rates for the IMN and SHS groups were 30.7% and 32.5%, respectively (AOR, 1.00; 95% CI, 0.90–1.07). The 1-year revision surgery rate was higher (AOR, 1.35; 95% CI, 1.16–1.57, p = .0001) in the IMN group compared with the SHS group (7.2% and 5.5%, respectively) (Table 2).

The mean number of inpatient days for the index hospitalization was higher (0.17; 95% CI, .012–0.32; p = .035) for the IMN group than the SHS group (6.5 and 6.3 days, respectively) (Table 2). The mean numbers of days spent as an inpatient during the first 6 months after injury for the IMN and SHS groups were 9.6 days and 9.3 days, respectively, which was not statistically significant (0.17; 95% CI, −0.16–0.49).

The total mean numbers of days using rehabilitation services for the IMN and SHS groups were 10.2 and 9.5 days, producing a significant adjusted increase in the IMN group of 0.56 days (95% CI, 0.07–0.93, p = 0.015)

Table 2. Primary and secondary outcome measures by treatment

Outcomes	Intramedullary nail	Sliding hip screw	Odds ratio* (95% CI)
Primary			
Crude revision surgery rate	7.2%	5.5%	1.35 (1.16–1.57)
Crude 30-day mortality	14.2%	15.8%	0.99 (0.89–1.11)
Crude 1 year mortality	30.7%	32.5%	1.0 (0.9–1.07)
Secondary			Adjusted difference IMN − SHS
Index length of stay	6.5 days	6.3 days	0.17 (0.012–0.32)
Inpatient days during first 6 months	9.6 days	9.3 days	0.17 (−0.15–0.49)
Days with usage of rehabilitation services during first 6 months	10.2 days	9.5 days	0.56 (0.07–0.93)
Utilization costs during first year	$16,854	$15,710	$947 (581–1313)

* Adjusted odds ratio for outcome with IMN relative to SHS.

(Table 2). Total costs (all physician and hospital costs) during the first year after injury were higher ($947; 95% CI, $581–$1313; $p < .001$) for patients in the IMN group ($16,854) than the SHS group ($15,710).

Discussion

This study was performed using a large cohort of Medicare beneficiaries to determine whether patients sustaining an intertrochanteric fracture have better outcomes when stabilized with a SHS or an IMN. We compared 1-year revision surgery rates, mortality, length of hospital stay, number of days using rehabilitation services, and costs associated with both implants.

The study's limitations include the fact this is a retrospective database study with all the problems inherent with this methodology. Although the patient groups appeared similar, patients were not randomly assigned to one of the implant groups; thus, unmeasured confounders may exist that were not adjusted for in this analysis and could have biased the results. However, using a national database of Medicare claims should provide a true indication of the actual care that is being received across the breadth of institutions in the United States, whereas trials often are performed in select institutions using restrictive entrance criteria. Similar to most database projects, users cannot independently verify the accuracy of the data. However, Baron et al. performed internal validation of Medicare data for patients sustaining a hip fracture or undergoing prostatectomy, comparing hospital and physician claims [6]; they found excellent agreement between the two claim sources with percentage of agreement generally between 89% to 99%.

Furthermore, the Medicare database does not include detailed clinical information such as medications, severity of the associated comorbidities, lifestyle factors, body composition of the patient, or radiographic information such as fracture comminution or displacement. Two studies had high failure of fixation for reverse obliquity intertrochanteric fractures managed with a SHS and recommended use of fixed angled devices or IMN for this fracture configuration [15, 22]. Because the incidence of reverse obliquity fractures is not known for our cohort, the higher reoperation rate in the IMN group could have been influenced by inclusion of patients with greater fracture instability.

The study period was from 1999 to 2001. This period was relatively early during acceptance of the IMN for stabilization of intertrochanteric fractures as evidenced by the fact that 94% of our cohort was treated using a SHS. Although the demographic characteristics of the two groups were not significantly different, there may have been a learning curve for use of IMN for intertrochanteric fracture stabilization. This learning curve may have influenced the higher complication rate associated with use of the IMN. The results may have been different using a more recent cohort as clinicians became more familiar with use of IM implants for stabilization of proximal femur fractures.

Therefore, we do not have all information necessary to fully evaluate the appropriateness of specific interventions or to control for all relevant patient and surgeon factors that may have affected the complication rates after hip fractures. In addition, billing codes may not always completely reflect the details of the clinical care. There is no way to determine whether the implants used were short or long IMN; the complication rates between these two types of IMN might be different. Furthermore, the problem of laterality (ie, the fact that ICD-9-CM codes do not reliably distinguish between left and right sides) prevented us from knowing with certainty whether adverse events after hip fracture treatment were related to the extremity treated surgically at the index stay. However, this limitation would apply to patients treated with either implant.

Trochanteric antegrade IM nailing of intertrochanteric fractures using a large screw placed up the neck to proximally interlock a short IMN gained popularity in the 1980s and 1990s. Early reports suggested some advantages to this fixation technique, including a minimally invasive surgical technique, shortened operating times, lower blood loss, improved biomechanics, greater fracture stability, earlier mobilization, and shorter lengths of stay [7, 8, 11, 16, 26]. However, authors soon reported numerous technical complications, including fracture of the femur below the nail and need for revision surgery [7, 8, 11, 26]. The initial nails, made by several manufacturers, were redesigned with a smaller nail and locking bolt diameter and lower angle proximal bend.

Despite the initial problems associated with initial trochanteric nails for treatment of intertrochanteric fractures, there has been increased use of these implants. Using American Board of Orthopaedic Surgery (ABOS) Part II data, Anglen and Weinstein reported that use of IM fixation increased from 3% in 1999 to 67% of cases in 2006 [3]. Numerous studies have been published comparing sliding compression hip screw and side plate with IM fixation [2, 12, 16, 17, 29, 31, 32]. However, results have been contradictory in terms of outcomes [2, 12, 16, 17, 29, 31, 32] with the only consistent differences reported between the two fixation techniques being increased complications (particularly intraoperative and postoperative fractures) and a higher reoperation rate with IMN [4, 10, 16, 29].

After adjusting for relevant covariates, we found considerably worse results for the IMN procedure based on the rates of revision surgery, length of stay during the index hospitalization, number of days using rehabilitation services, and total costs accumulated during the year after fracture inclusive of the index hospitalization. We found no differences in the adjusted 30-day or 1-year mortality rate or number of days spent hospitalized during the first 6 months after fracture.

The risk for revision surgery during the first postoperative year was 35% greater for the IMN group compared with the SHS group (7.2% and 5.5%, respectively). This result is consistent with published revision surgery rates for intertrochanteric femur fractures managed with IMN and SHS. In a prospective, randomized trial of 400 intertrochanteric fractures randomized to either a Gamma nail (Stryker Medical, Mahwah, NJ) or SHS, Adams et al. reported 1-year revision surgery rates of 6% for the IMN and 4% for the SHS [1]. In a retrospective review of 921 pertrochanteric fractures treated in Oslo, Norway, Osnes et al. reported revision surgery rates of 11.7% for fractures stabilized using a Gamma nail and 8.1% for those treated with a SHS [30]. Parker and Handoll, comparing use of a cephalomedullary nail with a SHS for stabilization of extracapsular hip fractures, reported the short IMN was associated with a significantly greater revision surgery rate than a SHS (relative risk, 1.56; 95% CI, 1.12–2.18) [33].

The crude and adjusted 30-day and 1-year mortality rates for the two groups were not significantly different and the values reported in our analysis are consistent with published rates [14, 16, 27, 28, 33, 34]. In a prospective, randomized series of 100 intertrochanteric fractures stabilized with either a cephalomedullary nail or SHS, Hardy et al. reported a 1-year mortality rate of 30% using either implant [16]. Parker and Handoll, comparing use of a cephalomedullary nail with a SHS for stabilization of extracapsular hip fractures, reported no difference in mortality with use of either implant [33].

The difference in adjusted length of stay between the IMN and SHS groups for the index hospitalization and during the first 6 months after injury was 0.17 days. This difference was statistically significant only for the index hospitalization as a result of the greater variability in days of hospitalization during the 6-month period, but was not of much clinical importance. These results are interesting considering the higher revision surgery rate for fractures stabilized using an IMN; because of this higher revision rate, one would expect a greater number of hospital days for patients treated with the IMN. The IMN group had an additional 0.5 day using rehabilitation services during the first 6 months after injury. This difference represents an increase of only approximately 5%. As a result of the subjective nature of treatment plans, this small difference could easily be caused by differences unrelated to the type of surgical treatment used.

Total standard costs were higher for the IMN group in unadjusted and adjusted analyses. Patients managed with IMN had $332 and $617 higher adjusted costs for hospital reimbursements and Part B claims during the first year, respectively. Overall adjusted cost estimates, combining the two (DRGs + RVUs) were $947 higher for the IMN group than for the SHS group. This represents an increase of approximately 6%. The higher costs for the IMN group can be explained partly by the higher rate of revision surgery, longer length of stay, and higher physician RVUs associated with using an IMN compared with a SHS (20.31 and 15.94 RVUs, where 1 RVU = $36.61). The average increased spending of $950 per patient during the first year after fracture becomes financially important in light of the the current 296,000 annual hospital admissions for patients with hip fractures and the anticipated increase in the number of future hip fractures [9].

Our study confirms the findings of others regarding a higher revision surgery rate for intertrochanteric femur fractures stabilized with an IMN compared with a SHS. In light of the higher revision surgery rate and total expenditures for the IMN group, this analysis does not support routine use of an IMN for management of all intertrochanteric femur fractures.

References

1. Adams CI, Robinson CM, Court-Brown CM, McQueen MM. Prospective randomized controlled trial of an intramedullary nail versus dynamic screw and plate for intertrochanteric fractures of the femur. *J Orthop Trauma*. 2001;15:394–400.
2. Ahrengart L, Tornkvist H, Fornander P, Thorngren KG, Pasanen L, Wahlstrom P, Honkonen S, Lindgren U. A randomized study of the compression hip screw and Gamma nail in 426 fractures. *Clin Orthop Relat Res*. 2002;401:209–222.
3. Anglen JO, Weinstein JN, American Board of Orthopaedic Surgery Reseach Committee. Nail or plate fixation of intertrochanteric hip fractures: changing pattern of practice. A review of the American Board of Orthopaedic Surgery database. *J Bone Joint Surg Am*. 2008;90:700–707.
4. Aune AK, Ekeland A, Odegaard B, Grogaard B, Alho A. Gamma nail vs compression screw for trochanteric femoral fractures:15 reoperations in a prospective, randomized study of 378 patients. *Acta Orthop Scand*. 1994;65:127–130.
5. Bannister GC, Gibson AG, Ackroyd CE, Newman JH. The fixation and prognosis of trochanteric fractures: a randomized prospective controlled trial. *Clin Orthop Relat Res*. 1990;254: 242–246.
6. Baron JA, Lu-Yao G, Barrett J, McLerran D, Fisher ES. Internal validation of Medicare claims data. *Epidemiology*. 1994;5:541–544.
7. Boriani S, Bettelli G, Zmerly H, Specchia L, Bungaro P, Montanari G, Capelli A, Canella P, Regnoli R, Rispoli R, et al. Results of the multicentric Italian experience on the Gamma nail: a report on 648 cases. *Orthopedics*. 1991;14:1307–1314.
8. Bridle SH, Patel AD, Bircher M, Calvert PT. Fixation of intertrochanteric fractures of the femur: a randomised prospective comparison of the Gamma nail and the dynamic hip screw. *J Bone Joint Surg Br*. 1991;73:330–334.
9. Burge R, Dawson-Hughes B, Solomon DH, Wong JB, King A, Tosteson A: Incidence and economic burden of osteoporosis-related fractures in the United States, 2005–2025. *J Bone Miner Res*. 2007;22:465–475.
10. Butt MS, Krikler SJ, Nafie S, Ali MS. Comparison of dynamic hip screw and gamma nail: a prospective, randomized, controlled trial. *Injury*. 1995;26:615–618.
11. Davis J, Harris MB, Duval M, D′Ambrosia R. Pertrochanteric fractures treated with the Gamma nail: technique and report of early results. *Orthopedics*. 1991;14:939–942.
12. Dujardin FH, Benez C, Polle G, Alain J, Biga N, Thomine JM. Prospective randomized comparison between a dynamic hip screw and a mini-invasive static nail in fractures of the trochanteric area: preliminary results. *J Orthop Trauma*. 2001;15:401–406.
13. Esser MP, Kassab JY, Jones DH. Trochanteric fractures of the femur: a randomised prospective trial comparing the Jewett nail-plate with the dynamic hip screw. *J Bone Joint Surg Br*. 1986;68:557–560.
14. Goldacre MJ, Roberts SE, Yeates D. Mortality after admission to hospital with fractured neck of femur: database study. *BMJ*. 2002;325:868–869.
15. Haidukewych GJ, Israel TA, Berry DJ. Reverse obliquity fractures of the intertrochanteric region of the femur. *J Bone Joint Surg Am*. 2001;83:643–650.
16. Hardy DC, Descamps PY, Krallis P, Fabeck L, Smets P, Bertens CL, Delince PE. Use of an intramedullary hip-screw compared with a compression hip-screw with a plate for intertrochanteric femoral fractures: a prospective, randomized study of one hundred patients. *J Bone Joint Surg Am*. 1998;80:618–630.
17. Harrington P, Nihal A, Singhania AK, Howell FR. Intramedullary hip screw versus sliding hip screw for unstable intertrochanteric femoral fractures in the elderly. *Injury*. 2002;33:23–28.
18. Heyse-Moore GH, MacEachern AG, Evans DC. Treatment of intertrochanteric fractures of the femur: a comparison of the Richards screw-plate with the Jewett nail-plate. *J Bone Joint Surg Br*. 1983;65:262–267.
19. http://www.ers.usda.gov/data/RuralUrbanCommunitingAreaCodes/. Accessed 4 Feb 2008.
20. Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, Hughes JS, Coffman GA. Identifying complications of care using administrative data. *Med Care*. 1994;32:700–715.
21. Jacobs RR, Armstrong HJ, Whitaker JH, Pazell J. Treatment of intertrochanteric hip fractures with a compression hip screw and a nail plate. *J Trauma*. 1976;16:599–603.
22. Kim WY, Han CH, Park JI, Kim JY. Failure of intertrochanteric fracture fixation with a dynamic hip screw in relation to pre-operative fracture stability and osteoporosis. *Int Orthop*. 2001;25:360–362.
23. Koval KJ, Lurie J, Zhou W, Sparks MB, Cantu RV, Sporer SM, Weinstein J. Ankle fractures in the elderly: what you get depends on where you live and who you see. *J Orthop Trauma*. 2005;19:635–639.
24. Koval KJ, Zuckerman JD. Intertrochanteric fractures. In: Heckman JD. Bucholz RW, eds. *Rockwood, Green′s Fractures in Adults*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2001:1635–1663.
25. Kyle RF, Cabanela ME, Russell TA, Swiontkowski MF, Winquist RA, Zuckerman JD, Schmidt AH, Koval KJ. Fractures of the proximal part of the femur. *Instr Course Lect*. 1995;44:227–253.
26. Lindsey RW, Teal P, Probe RA, Rhoads D, Davenport S, Schauder K. Early experience with the gamma interlocking nail for peritrochanteric fractures of the proximal femur. *J Trauma*. 1991;31:1649–1658.
27. Miller CW. Survival and ambulation following hip fracture. *J Bone Joint Surg Am*. 1978;60:930–934.
28. Moran CG, Wenn RT, Sikand M, Taylor AM. Early mortality after hip fracture: is delay before surgery important? *J Bone Joint Surg Am*. 2005;87:483–489.
29. O′Brien PJ, Meek RN, Blachut PA, Broekhuyse HM, Sabharwal S. Fixation of intertrochanteric hip fractures: gamma nail versus dynamic hip screw. A randomized, prospective study. *Can J Surg*. 1995;38:516–520.
30. Osnes EK, Lofthus CM, Falch JA, Meyer HE, Stensvold I, Kristiansen IS, Nordsletten L. More postoperative femoral fractures with the Gamma nail than the sliding screw plate in the treatment of trochanteric fractures. *Acta Orthop Scand*. 2001;72:252–256.
31. Pajarinen J, Lindahl J, Michelsson O, Savolainen V, Hirvensalo E. Pertrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail: a randomised study comparing post-operative rehabilitation. *J Bone Joint Surg Br*. 2005;87:76–81.
32. Park SR, Kang JS, Kim HS, Lee WH, Kim YH. Treatment of intertrochanteric fracture with the Gamma AP locking nail or by a compression hip screw: a randomised prospective trial. *Int Orthop*. 1998;22:157–160.
33. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. *Cochrane Database Syst Rev*. 2005;4:CD000093.
34. Roberts SE, Goldacre MJ. Time trends and demography of mortality after fractured neck of femur in an English population, 1968–98: database study. *BMJ*. 2003;327:771–775.
35. Zuckerman JD. Hip fracture. *N Engl J Med*. 1996;334:1519–1525.