THE JOURNAL OF BONE & JOINT SURGERY (BR)

Pertrochanteric femoral fractures treated with a dynamic hip screw or a proximal femoral nail

A RANDOMISED STUDY COMPARING POST-OPERATIVE REHABILITATION

J. Pajarinen,
J. Lindahl,
O. Michelsson,
V. Savolainen,
E. Hirvensalo

From Helsinki University Central Hospital, Helsinki, Finland

We treated 108 patients with a pertrochanteric femoral fracture using either the dynamic hip screw or the proximal femoral nail in this prospective, randomised series. We compared walking ability before fracture, intra-operative variables and return to their residence. Patients treated with the proximal femoral nail (n = 42) had regained their pre-operative walking ability significantly (p = 0.04) more often by the four-month review than those treated with the dynamic hip screw (n = 41). Peri-operative or immediate post-operative measures of outcome did not differ between the groups, with the exception of operation time. The dynamic hip screw allowed a significantly greater compression of the fracture during the four-month follow-up, but consolidation of the fracture was comparable between the two groups. Two major losses of reduction were observed in each group, resulting in a total of four revision operations.

Our results suggest that the use of the proximal femoral nail may allow a faster post-operative restoration of walking ability, when compared with the dynamic hip screw.

The incidence of pertrochanteric femoral fractures has increased significantly during recent decades, and this tendency will probably continue in the near future due to the rising age of the population.[1,2] The goal of the treatment of these fractures is stable fixation, which allows early mobilisation of the patient. In order to achieve this objective, several intramedullary nails have been developed. These nails may challenge the previous role of the compression screw as the standard method of fixation. The advantages and disadvantages of the original design of the Gamma nail have been well established in previous studies, usually by comparing the results with the dynamic hip screw (DHS).[3] Less data are available about an alternative, the proximal femoral nail (PFN), since most previous studies are retrospective and lack a control group.[4,5] Moreover, the main focus in previous controlled studies has been aimed at technique and clinical results, or on the rehabilitation of the patients in general.[6] We do not know if there is a difference in the post-operative recovery of walking, or where the patient lives, depending upon which implant is used.

The purpose of this study was to assess the patients' recovery after operative treatment of a pertrochanteric femoral fracture with either DHS or PFN, in a randomised, prospective series of 108 patients.

Patients and Methods

Between October 1999 and February 2001, we randomised 108 patients with low-energy extracapsular pertrochanteric femoral fractures (AO category 31-A)[7] to be treated with the dynamic hip screw (Synthes-Stratec, Oberdorf, Switzerland) or the proximal femoral nail (Synthes-Stratec). The ethics committee of our hospital approved the study plan and informed consent was obtained from all patients before the operation. Everyone admitted to our hospital with a pertrochanteric fracture during the study period was considered eligible for the study, but those with a pathological fracture, multiple injuries, and who were unable to give informed consent or refused to participate, were excluded.

Plain radiographs were obtained on admission, and all fractures were categorised according to the AO/ASIF classification.[7] The mode of treatment was determined by strict randomisation, using sealed envelopes. The domestic circumstances of each patient was classified into three categories: living in one's own home, in a nursing home, or an institution such as a long-stay hospital ward. Walking ability was classified into three categories: able to walk independently without aids, walking independently with the help of aids (crutches or frame) and walking only when assisted by another person. The use of a walking stick was

J. Pajarinen, MD, Orthopaedic Surgeon
J. Lindahl, MD, Consultant Orthopaedic Surgeon
O. Michelsson, MD, Orthopaedic Surgeon
V. Savolainen, MD, Orthopaedic Surgeon
E. Hirvensalo, MD, Orthopaedic Surgeon
Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, P O Box 266, Helsinki 00029-FIN, Finland.

Correspondence should be sent to Dr J. Pajarinen.

doi:10.1302/0301-620X.87B1.15249 $2.00

J Bone Joint Surg (Br) 2005;87-B:76-81.
Received 30 December 2003; Accepted after revision 5 March 2004

Fig. 1a

Fig. 1b

Figure 1a – An 87-year-old woman sustained an AO type A1.2 pertrochanteric fracture when she fell outside her home. Figure 1b – The fracture was reduced and fixed the same day with a dynamic hip screw, with an acceptable post-operative result. Healing of the fracture occurred uneventfully, and the patient had returned to living at home. She was able to walk independently at four months.

Fig. 2a

Fig. 2b

Fig. 2c

Figure 2a – An 83-year-old woman sustained an AO type A1.2 pertrochanteric fracture on the left in a fall at home. She had sustained a pertrochanteric fracture on the right several years earlier, treated with a dynamic hip screw. She lived at home and was able to walk independently. Figure 2b – The fracture was reduced and fixed with a proximal femoral nail the following day, with an acceptable post-operative result. Figure 2c – Healing of the fracture occurred uneventfully, but some displacement of the tip of the greater trochanter occurred. She had returned to living at home and was able to walk independently at four months.

not considered to be an extra aid, and patients using one were categorised as independent walkers.

The operation was usually performed within two days of admission, in most cases by a senior orthopaedic resident. All fractures were reduced by closed means. Standard operative techniques, which are recommended by the manufacturer and have been described in detail in instruction manuals or earlier studies[7,8] were used. All patients received a prophylactic dose of an intravenous antibiotic, and were also treated with low-molecular-weight heparin during their stay in hospital. Intra-operative factors were considered as secondary outcome measures.

Plain anteroposterior (AP) and lateral radiographs were obtained on the first post-operative day, and analysed for reduction of the fracture and position of the implant. Reduction was considered good if the cortical congruence at the calcar region was restored, and if the displacement between the fragments did not exceed 2 mm in any projection. The ideal position for the screw in the femoral neck for both the DHS and the PFN was defined as being central on the lateral radiograph and central or inferior on the AP radiograph[9] (Figs 1 and 2).

Walking weight-bearing within the limits of pain was usually begun on the first or second post-operative day. The rehabilitation protocol was uniform, regardless of the method of fixation. The patients were discharged when mobile and primary complications had been excluded.

Follow-up reviews were undertaken at six weeks and four months post-operatively. Plain AP and lateral radiographs were obtained at both visits. All changes in the position of the fracture and implant, when compared with the post-operative radiographs, were recorded and considered as secondary measures of outcome. Where the patient lived and their ability to walk were recorded as in the pre-operative phase. A return to the pre-operative level was considered as a primary measure of outcome.

The statistical analysis was performed using SPSS for Windows (SPSS Inc, Chicago, Illinois). Odds ratios and means were compared between the groups, with 95% confidence intervals (CI) excluding the value of one and zero respectively, being considered as statistically significant differences. P values were calculated with independent samples *t*-test and with cross-tabulation using Fisher's exact test; values of $p < 0.05$ were considered as significant.

Table I. Pre-fracture variables in 108 patients with a pertrochanteric fracture treated either with a dynamic hip screw (DHS) or proximal femoral nail (PFN)

	Total n = 108 (%)	DHS n = 54 (%)	PFN n = 54 (%)
Gender			
Female	81 (75.0)	40 (74.1)	41 (75.9)
Male	27 (25.0)	14 (25.9)	13 (24.1)
Mean ± SD	80.6 ± 9.9	80.3 ± 10.8	80.9 ± 9.1
Body mass index ± SD	21.8 ± 3.3	22.3 ± 3.6	21.4 ± 3.0
Previously diagnosed dementia	26 (24.1)	14 (25.9)	12 (22.2)
Injury mechanism			
Falling at home	97 (89.8)	48 (88.9)	49 (90.7)
Falling outside home	11 (10.2)	6 (11.1)	5 (9.3)
Residence			
Own home	69 (63.9)	33 (61.1)	36 (66.7)
Nursing home	28 (25.9)	16 (29.6)	12 (22.2)
Institution	11 (10.2)	5 (9.3)	6 (11.1)
Walking ability			
No aids needed	65 (60.2)	34 (63.0)	31 (57.4)
In need of aids, but independent	38 (35.2)	19 (35.2)	19 (35.2)
In need of assistance	4 (3.7)	0	4 (7.4)
Reliable data not available	1 (0.9)	1 (1.9)	0
Fracture type (AO)[7]			
A1.1	16 (14.8)	7 (13.0)	9 (16.7)
A1.2	31 (28.7)	19 (35.2)	12 (22.2)
A2.1	26 (24.1)	14 (25.9)	12 (22.2)
A2.2	24 (22.2)	10 (18.5)	14 (25.9)
other	11 (10.2)	4 (7.4)	7 (13.0)
Mean treatment delay in days (SD)	1.4 ± 1.8	1.5 ± 2.4	1.3 ± 1.1
ASA*			
2	14 (13.0)	8 (14.8)	6 (11.1)
3	60 (55.6)	32 (59.3)	28 (51.9)
4	34 (31.5)	14 (25.9)	20 (37.0)

* American Society of Anesthesiologists scoring[22]

Results

The two treatment groups were comparable in features before the fracture occurred (Table I). The median operation time was 50 minutes (20 to 200), with the operation of PFN being generally more time consuming (Table II). The mean blood loss was 339 ml (50 to 2800), and the mean number of transfused red blood cell units (400 cc/unit) during the hospital stay was 2.6 (0 to 11). Spinal anaesthesia was used in 103 (95.4%) of the 108 operations. Reduction of the fracture was considered good in 68 (63.0%), and the position of the implant as ideal in 85 (78.7%) of the post-operative radiographs. The patients were discharged at a mean of six days (1 to 15) post-operatively usually to a rehabilitation hospital (92 patients, 85.2%). Two patients died in the immediate post-operative period from cardiovascular causes.

Five complications were observed during the follow-up of four months. There were two cases of redisplacement of the fracture in both groups (Table III). All four patients had revision operations. One case of heterotopic ossification, corresponding to Brooker class 4,[10] was observed where a PFN had been used. However, this finding did not affect the patient's recovery and walking ability was regained at four months. No superficial or deep wound infections, or deep vein thromboses, were observed.

At four months, 87 (80.6%) of the initial 108 patients were eligible for an analysis of outcome. Of the 21 not eligible for analysis, two died in the immediate post-operative period and another four died before completion of the follow-up. Fifteen patients did not attend final review because they were too ill. The four patients who had revisions were excluded, and a final analysis of the outcome was thus performed for 83 patients (Table IV). The mean compression of the fracture, indicated as shortening of the femoral neck, was 3.6 mm (0 to 30), with a significant difference between the groups (Table V). The mean shortening of the shaft of the femur was 3.5 mm (0 to 25), when measured from AP radiographs. At four months follow-up, 46 (55.4%) patients lived in their own home, 16 (19.3%) in a nursing

Table II. Intra-operative factors in 108 patients with a pertrochanteric fracture treated either with a dynamic hip screw (DHS) or proximal femoral nail (PFN)

	DHS (n = 54)	PFN (n = 54)	p value
Anaesthesia (%)			
General	2 (3.7)	3 (5.6)	1.000
Spinal	52 (96.3)	51 (94.4)	
Median operation time in minutes* (range)	45 (20 to 105)	55 (35 to 200)	0.011*
Blood loss in ml ± SD	357 ± 495	320 ± 310	0.644
Mean transfused units of RBC ± SD	2.6 ± 2.0	2.6 ± 2.4	0.950
Ideal implant position (%)†	40 (74.1)	45 (83.3)	0.231
Good fracture reduction (%)‡	30 (55.6)	38 (70.4)	0.108
Mean hospitalisation time in days ± SD	5.4 ± 3.0	6.1 ± 3.3	0.251
Discharged to: (%)			
Own home	4 (7.4)	6 (11.1)	0.742
Nursing home	2 (3.7)	1 (1.9)	1.000
Rehabilitation hospital	48 (88.9)	45 (83.3)	0.579
Died at our hospital	0	2 (3.7)	0.495

* statistically significant difference between the groups
† defined for both the DHS and the PFN as a central position of the neck screw on the lateral radiograph and a central or inferior position on the AP radiograph
‡ cortical congruence at the calcar region restored and the displacement between the fragments not exceeding 2 mm in any projection

Table III. Features of four fractures with collapse during the four-month follow-up in a series of 108 patients with a pertrochanteric fracture treated with a dynamic hip screw (DHS) or proximal femoral nail (PFN)

Gender	Age (yrs)	Fracture type (AO)[9]	Implant	Primary reduction*	Implant position†	Time to failure (wks)	Screw cut-out
Female	78	A1.1	DHS	Not good	Ideal	4	Yes
Female	75	A1.2	PFN	Good	Ideal	13	Yes
Male	90	A1.2	PFN	Not good	Not ideal	17	No
Female	82	A2.2	DHS	Not good	Ideal	13	No

* good if cortical congruence at the calcar region was restored and the displacement between the fragments did not exceed 2 mm
† ideal implant position: see Table II

Table IV. Comparison of the 21 patients who were withdrawn and the 83 who were eligible for analysis at four months, 41 treated with a dynamic hip screw (DHS) and 42 with a proximal femoral nail (PFN)

	Withdrawn (n = 21)	DHS (n = 41)	PFN (n = 42)
Sex (%)			
Female	14 (66.7)	30 (73.2)	34 (81.0)
Male	7 (33.3)	11 (26.8)	8 (19.0)
Mean age ± SD	84.3 ± 7.5	79.0 ± 11.5	80.2 ± 9.4
Mean body mass index ± SD	21.9 ± 3.2	22.3 ± 3.7	21.2 ± 2.9
Diagnosed dementia (%)	5 (21.7)	11 (26.2)	10 (23.3)
Injury mechanism (%)			
Falling indoors	19 (90.5)	36 (87.8)	40 (95.2)
Falling outside	2 (9.5)	5 (12.2)	2 (4.8)
Habitation pre-operatively (%)			
Own home	13 (61.9)	27 (65.9)	26 (61.9)
Nursing home	7 (33.3)	10 (24.4)	10 (23.8)
Institution	1 (4.8)	4 (9.8)	6 (14.3)
Walking ability pre-operatively (%)			
No aids required	12 (57.1)	26 (63.4)	23 (54.8)
In need of aids, but independent	7 (33.3)	15 (36.6)	16 (38.1)
In need of assistance	1 (4.8)	0	3 (7.1)
Reliable data not available	1 (4.8)	0	0
ASA (%)*			
2	2 (9.5)	7 (17.1)	5 (11.9)
3	9 (42.9)	24 (58.5)	23 (54.8)
4	10 (47.6)	10 (24.4)	14 (33.3)

* American Society of Anesthesiologists scoring[22]

home and 21 (25.3%) in an institution; 27 (32.5%) patients were able to walk independently, 46 (55.4%) needed crutches or a frame, and ten (12.0%) were unable to walk independently. Their domestic status and walking ability were restored to pre-operative levels in 66 (79.5%) and 54 (65.1%) patients, respectively. Restoration of walking ability was achieved more often in the patients treated with a PFN (76.2%) compared with those treated with a DHS (53.7%; p = 0.040) (Table VI).

Discussion

The use of a DHS has been supported by biomechanical properties[11] which are assumed to improve the healing of fractures. At present, the longest follow-up studies available are those of the Gamma nail (Stryker Howmedica, Freiburg, Germany). Although acceptable rates of fracture healing have been reported,[12] several studies have shown an increased risk of both operative and post-operative complications, mainly femoral fractures, associated with the original design of this nail.[13,14] Recent meta-analyses have suggested that the DHS should be favoured for the treatment of pertrochanteric fractures.[15,16] The PFN has been developed as an alternative to the Gamma nail, and it seems to be associated with a lower incidence of complications.[17] So far, the published reports of the PFN are promising, although much of the data are available only from retrospective studies which do not include a control group.

One of the few controlled studies of the PFN is a randomised series of 168 patients, in which several intra-operative, radiographic and clinical measures of outcome were compared between the DHS and PFN after a minimum follow-up of one year.[18] In line with our results, 87 (51.8%) of the patients lived at home, but the authors did not report the number of patients who were able to walk independently. Although the mean pre- and post-operative scores of function and mobility did not differ significantly between the treatment groups, there was an increase by a factor of 1.5 in the score for social function during follow-up in the PFN group compared with the DHS group. Moreover, the score for mobility was reduced more in the patients treated with PFN. The statistical significance of these observations, as well as the power of the study, were not reported.[18] The results from that study suggest that the use of a DHS may allow more patients to return to their previous level of activity.[18] In contrast, patients in our study who were treated with a PFN regained their pre-operative walking ability at four months significantly more often than those treated with a DHS. Although the statistical power of this finding was not very strong, it suggests that the use of a PFN may favour better restoration of function in the elderly population, compared with the use of a DHS. One explanation might be the significantly greater impaction of the fracture in the DHS group, with shortening of the femoral neck. It is possible that substantial compression of the fracture may alter the biomechanics of the hip and prevent the restoration of the ability to walk. Post-operative mobilisation was equally successful for both groups, which suggests that the differences between the implants are insignificant in the primary phase. Moreover, the lack of compression in the PFN group did not seem to interfere with the healing of the fracture.

Approximately 50% of patients returned to where they had lived before their operation, without any correlation to

Table V. Radiographic findings at four months post-operatively in 83 patients with a pertrochanteric fracture treated either with a dynamic hip screw (DHS) or proximal femoral nail (PFN)

	DHS (n = 41)	PFN (n = 42)	Difference of means (95% CI)	p
Mean shortening of the femoral neck in mm ± SD	6.1 ± 8.2	1.3 ± 3.1	4.7 (1.7 to 7.8)*	0.003*
Mean shortening of the femoral shaft in mm (SD)	4.7 ± 6.4	2.5 ± 3.2	2.2 (-0.3 to 4.7)	0.081
Femoral neck-shaft whose angle difference to contralateral side > 5° (%)	14 *(34.1)*	11 *(26.2)*		0.785

* statistically significant difference

Table VI. Place of residence, walking ability, and recovery to the pre-operative level at four months' follow-up in 83 patients

	DHS*	PFN†	Odds ratio (95% CI)	p value
Residence (%)				
Own home	22 *(53.7)*	24 *(57.1)*	1.2 (0.5 to 2.7)	0.827
Nursing home	6 *(14.6)*	10 *(23.8)*	1.8 (0.6 to 5.6)	0.405
Institution	13 *(31.7)*	8 *(19.0)*	1.9 (0.7 to 5.4)	0.214
Recovery of abilities to their pre-operative status (%)				
Yes	32 *(78.0)*	34 *(81.0)*	0.8 (0.3 to 2.4)	0.791
No	9 *(22.0)*	8 *(19.0)*		
Walking ability (%)				
No aids needed	12 *(29.3)*	15 *(35.7)*	1.3 (0.5 to 3.4)	0.641
In need of aids, but independent	22 *(53.7)*	24 *(57.1)*	0.9 (0.4 to 2.1)	0.827
In need of assistance	7 *(17.1)*	3 *(7.1)*	0.4 (0.1 to 1.6)	0.194
Recovery of walking ability to the pre-operative status (%)				
Yes	22 *(53.7)*	32 *(76.2)*	0.4 (0.1 to 0.9)‡	0.040
No	19 *(46.3)*	10 *(23.8)*		
Drop-out patients				
Fracture redisplacement	2	2	1.0 (0.1 to 7.4)	1.000
Died before follow-up was completed	2	4	0.5 (0.1 to 2.7)	0.678
Did not attend final review	9	6	1.6 (0.5 to 4.9)	0.578
Total	54	54		

* DHS, dynamic hip screw
† PFN, proximal femoral nail
‡ statistically significant difference

the implant which was used. This finding agrees with the results from retrospective studies of Banan et al,[19] Al-Yassari et al[20] and Simmermacher et al[8] who also observed restoration of pre-operative mobility in approximately 40% to 50% of the patients treated with a PFN. Similarly, the use of a DHS and a Gamma nail seems to generate comparable results.[14,21] It therefore seems reasonable to expect approximately half the patients with a pertrochanteric fracture to resume their pre-operative domestic status at the time of healing of the fracture, regardless of the method of treatment used. However, even better results have been reported.[4]

In respect of secondary measures of outcome, only operation time differed significantly between the treatment groups. Re-displacement of the fracture occurred in an equal percentage of patients in both groups. Fracture of the femoral diaphysis at the tip of the nail is a known complication associated with the use of intramedullary nails in the treatment of proximal femoral fractures. We did not observe any in our series but our follow-up was short.

A common problem in previous studies, as in ours, is the high number of those who were withdrawn, even after a short follow-up. This is partially explained by the age of the patients. In our series, the 19 patients who did not attend their final review had either died during the first four months after operation at another hospital, or were too ill to attend. Although the high drop-out rate may bias the outcome when the overall recovery from the operation is assessed, it does not change the interpretation of the results when the two methods are compared, if the rate is equal between the two groups.

Our results suggest that the use of a PFN in the treatment of trochanteric femoral fractures may have a positive effect on the speed of restoration of walking, when compared with patients treated with a DHS. The relatively well-restored anatomy of the hip may explain this. As our results partially conflict with previous reports, more randomised studies with larger numbers of patients are needed in order to decide which is the ideal implant for the treatment of these fractures.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References

1. **Kannus P, Oarkkari J, Sievänen H, et al.** Epidemiology of hip fractures. *Bone* 1996;18 (Suppl 1):57-63.
2. **Gullberg B, Duppe H, Nilsson B, et al.** Incidence of hip fractures in Malmö, Sweden (1950-1991). *Bone* 1993;14 (Suppl 1):23-9.
3. **Ahrengart L, Törnqvist H, Fornander P, et al.** A randomised study of the compression hip screw and Gamma nail in 426 fractures. *Clin Orthop* 2002;401:209-22.
4. **Domingo LJ, Cecilia D, Herrera A, Resines C.** Trochanteric fractures treated with a proximal femoral nail. *Int Orthop* 2001;25:298-301.

5. **Boldin C, Seibert FJ, Fankhauser F, et al.** The proximal femoral nail (PFN): a minimal invasive treatment of unstable proximal femoral fractures: a prospective study of 55 patients with a follow-up of 15 months. *Acta Orthop Scand* 2003;74:53-8.
6. **Hausko T, Karppi P, Avikainen V, Kautiainen H, Salkava R.** Intensive goriatric rehabilitation of hip fracture patients. *Acta Orthop Scand* 2002;73:425-31.
7. **Hoffman R, Haas NP.** Femur: proximal. In: Ruedi TP, Murphy WM, eds. *AO principles of fracture management*. Stuttgart, etc: Thieme, 2000:441-54.
8. **Simmermacher RKJ, Bosch AM, van der Werken C.** The AO/ASIF proximal femoral nail (PFN): a new device for the treatment of unstable proximal femoral fractures. *Injury* 1999;30:327-32.
9. **Wu C-C, Shih C-H, Lee M-Y, Tai C-L.** Biomechanical analysis of location of lag screw of a dynamic hip screw in treatment of unstable intertrochanteric fractures. *J Trauma* 1996;41:699-702.
10. **Brooker A, Bowerman J, Robinson R, Riley LH Jr.** Ectopic ossification following total hip replacement: Incidence and a method of classification. *J Bone Joint Surg (Am)* 1973;55-A:1629-32.
11. **Rosenblum SF, Zuckerman JD, Kummer FJ, Ram BS.** A biomechanical evaluation of the Gamma nail. *J Bone Joint Surg (Br)* 1992;74-B:352-7.
12. **Valverde J, Alonso M, Porro J, et al.** Use of Gamma nail in the treatment of fractures of the proximal femur. *Clin Orthop* 1998;350:56-61.
13. **Aune AK, Ekeland A, Grongaard B, Odegaard B, Alho A.** Gamma nail vs compression screw for trochanteric femoral fractures: 15 reoperations in a prospective, randomised study of 378 patients. *Acta Orthop Scand* 1994;65:127-30.
14. **Butt MS, Krikler SJ, Nafie S, Ali MS.** Comparison of dynamic hip screw and Gamma nail: a prospective, randomized, controlled trial. *Injury* 1995;25:615-18.
15. **Parker MJ, Handoll HHG.** Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures. *Cochrane Musculoskeletal Injuries Group Cochrane Database of Systematic Reviews*. 3, 2003.
16. **Parker MJ, Pryor GA.** Gamma nailing versus DHS for extracapsular femoral fractures: a meta-analysis of 10 randomised trials. *Int Orthop* 1996;20:163-8.
17. **Herrera A, Domingo LJ, Calvo A, Martinez A.** A comparative study of trochanteric fractures treated with the Gamma nail of the proximal femoral nail. *Int Orthop* 2002; 26:305-9.
18. **Saudan M, Lübbeke A, Sadowski C, et al.** Pertrochanteric fractures: is there an advantage to an intramedullary nail? *J Orthop Trauma* 2002;16:386-93.
19. **Banan H, Al-Sabti A, Jimulia T, Hart AJ.** The treatment of unstable, extracapsular hip fractures with the AO/ASIF proximal femoral nail (PFN): our first 60 cases. *Injury* 2002;33:401-5.
20. **Al-Yassari G, Langstaff RJ, Jones JWM, Al-Lami M.** The AO/ASIF proximal femoral nail (PFN) for the treatment of unstable trochanteric femoral fracture. *Injury* 2002; 33:395-9.
21. **Madsen J, Næss L, Aune A, et al.** Dynamic hip screw with trochanteric stabilizing plate in the treatment of unstable proximal femoral fractures: a comparative study with the Gamma nail and compression hip screw. *J Orthop Trauma* 1998;12:241-8.
22. **Owens WD, Felts JA, Spitznagel EL.** ASA physical status classifications: a study of consistency ratings. *Anesthesiology* 1978;49:239-43.