Sport related proximal femoral fractures: a retrospective review of 31 cases treated in an eight year period

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Abstract

In an eight year period, 31 patients with proximal femoral fractures resulting from sports accidents were treated by implantation of either a Gamma nail or a dynamic hip screw. Return to work or sports and the time to bone healing did not differ very much between the treatments. Gamma nailing was clearly the best with regard to stability and time to full mobilisation (4.5 days), but required 39 minutes to perform compared with insertion of a dynamic hip screw (27 minutes). The incidence of complications and malalignments did not differ very much between the two, although, when Gamma nailing was first used in the authors' clinic, more intraoperative complications occurred than with the dynamic hip screw. Stable pertrochanteric fractures may be treated with a dynamic hip screw. Unstable pertrochanteric or subtrochanteric fractures are treated with a Gamma nail at the authors' institution.

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Although Austria is a small country with only eight million inhabitants, the cost of sick leave after sports injuries amounted to 420 000 000 \$ in 1995. Some 15 000 Austrians sustained their injury during skiing (compared with 58 000 ski accidents for foreign tourists), 3000 in cross country skiing, 3000 in mountain biking, 3000 in paragliding, and 4000 in mountain climbing (data obtained from Dr Robert Bauer of the Institute of "Safe Living", a subdivision of the "Control Board for Safer Traffic", Ötzeltgasse 3, A-1031 Vienna, Austria). Proximal femoral fractures pose a special challenge to the orthopaedic surgeon as there is a considerable risk that a return to normal cannot be achieved. As the severity of the injury cannot be influenced, successful outcome depends on the stability of the osteosynthesis, an adequate rehabilitation program, and the patient's compliance. This paper deals with 31 patients seen over an eight year period suffering from sports related pertrochanteric or subtrochanteric femoral fractures, treated by insertion of either a dynamic hip screw (DHS) or a Gamma nail respectively.

Materials and methods

From 1988 to 1996, 31 patients were operated on for either pertrochanteric or subtro-

chanteric fractures after sports accidents. Additional injuries were present in one mountain biker, namely a concomitant tibial fracture, a clavicular fracture, and a radius fracture.

Four patients with a pertrochanteric fracture were treated by implantation of a 135° DHS plus a four hole plate, and five with a Gamma nail (fig 1A). They were two women and seven men with an average age of 41 (range 28-46)

Figure 1 Femoral fracture types treated. (A) pertrochanteric fracture types ($n = 9$); (B) subtrochanteric fracture types ($n = 22$). DHS, dynamic hip screw. Schematic drawings adapted from Müller et al.¹

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years. They sustained their fractures during mountain biking (three), skiing (five), and tobogganing (one).

For the subtrochanteric fractures, a 135° DHS with a long plate (six holes or more) was implanted in ten patients while a Gamma nail was used in 12 (fig 1B). There were three women and 19 men with an average age of 39 (range 34–56) years. The cause of the trauma was mountain biking in 10 and skiing in 12 patients.

The two devices used reflect the change in methods during the course of time. Before the Gamma nail became available in 1992, a DHS with a four hole plate was used for pertrochanteric fracture, while a DHS with a six hole plate (or longer) was used for subtrochanteric ones. Fractures were classified as described by Müller *et al*¹ (fig 1A,B). After routine checks at six weeks, three months, six months, and one year after surgery, all patients had a further follow up two years after the original injury, six months after removal of the stabilising device. This included radiographs of the pelvis, and anteroposterior and axial views of the injured hip using a standard distance of the x ray beam to assess variations in the cervicodiaphyseal angle. Leg length was assessed clinically measuring the distance between the anterior, superior iliac spine, and the tip of the medial malleolus. Bone healing was assumed when the fracture gap was not visible on the radiograph. Clinically, patients were able to use their leg without discomfort for the main activities of daily living but not for sport.

STATISTICAL ANALYSIS

Data for each patient were collected before and after the operation and computerised using the various versions of dBase, MS-Access, and MS Excel. Student's *t* test was used with $\alpha \leq 0.05$.

DETAILS OF TREATMENT

After admission, a strict shock regimen was observed using Ringer lactate (or later on Expahes) and blood was replaced if necessary. All patients were given antithrombotic treatment consisting of 5000 units Sandoparine (more recently 2500 units Fragmin has been used instead) once a day from the day of admission until discharge from the trauma ward. All patients were operated on, within six hours of admission, under general anaesthesia using a Maquet table and two image intensifiers.² After the operation, patients were

positioned on a CPM machine. Bed rest was for five days in the group receiving a DHS. Patients receiving Gamma nails were allowed to bear their full weight two days after surgery. After discharge from the ward, an outpatient physiotherapy regimen was begun by all patients for an average of 12 weeks. Patients with subtrochanteric fractures treated with a DHS were advised not to bear any weight for a minimum of six weeks. Gradual weight bearing was allowed thereafter according to the radiographic status.

Results (table 1)

OPERATION TIME (INCLUDING THE TIME BETWEEN SKIN INCISION AND THE LAST STITCH)

This varied between 27 (range 15–29) minutes for a DHS with a four hole plate and 39 (range 34–42) minutes required for a Gamma nail ($p < 0.05$; *t* test). The differences in operation time between the implantation of a DHS with a four hole plate and one with a six hole plate were, of course, statistically significant. No statistical differences existed in the operation time between implantation of the other devices (short/long Gamma nail, short DHS/Gamma nail, long DHS/long Gamma nail).

BLOOD LOSS

Gamma nailing (short nail 1040 ml, long nail 1200 ml) was associated with the highest blood loss expressed in various ways: in the blood remaining in the suction drain (statistically significant difference between the two DHS types, a short DHS and a short Gamma nail, and a long DHS and a long Gamma nail respectively, $p < 0.05$); in decrease in haemoglobin level 48 h after surgery (statistically significant, $p < 0.05$ between the two DHS types, between the DHS and the short Gamma nail, between a long DHS and a long Gamma nail); and volume of replacement blood required (between a DHS plus four hole plate and a Gamma nail, and between a long DHS and a long Gamma nail respectively, $p < 0.05$).

MALALIGNMENT (TABLE 2)

Five of 31 patients (16%) showed some degree of malalignment including two patients with a combination of varus and leg shortening (one four hole and one six hole plated DHS respectively), while one had had a valgus and external rotation malalignment (DHS). Of the patients with Gamma nails, one presented with a 15° valgus angulation and one with a 10° varus

Table 1 Methods, number of procedures, operation time, blood loss (measured in fall in haemoglobin level, content of the suction drain, RPB units), and days to mobilisation

Method	DHS	DHS I*		Gamma nail	Gamma nail I*	
Number	4	10		5	12	31
			Average			Average
Operation time (minutes)	27.3 (15–29)	48.5 (37–55)	37.9	39.2 (34–42)	36.8 (34–42)	38.0
Hb level 48 h po	10 (9.8–10.4)	9.3 (8.8–10)	9.7	9 (8.6–9.4)	8.8 (6.5–10)	8.9
Blood loss in ml†	425 (400–460)	659 (450–900)	542.0	800 (580–900)	823 (600–1000)	811.3
RBP units po‡	1.3 (1–2)	1.9 (1–3)	1.6	2.6 (2–3)	3 (2–4)	2.8
Mobilisation§	6.5 (6–7)	5 (5–7)	5.8	5 (3–5)	4 (3–5)	4.5

Values in parentheses are ranges. DHS, dynamic hip screw.

*Long plate (more than six holes) or long Gamma nail respectively.

†Average volume of blood (ml) in the suction drain 48 hours after the operation.

‡Units of transfused RBP.

§Mobilisation with crutches given as number of days after the operation.

Table 2 Malalignment related to devices

Treatment	Alignment			Leg length 1 cm*	Rotation (external)
	10 val	10 var	15 val		
DHS	1	1		1	1
DHS long		1		1	
Long Gamma nail	1	3	1	2	2

DHS, dynamic hip screw. 10 val, 10° valgus; 10 var, 10° varus; 15 val, 15° valgus. *Leg length difference; shortening of 1 cm.

alignment and excessive external rotation (fig 2). Shoe risers were used to treat the two patients presenting with a leg length difference of 1 cm.

HIP JOINT MOTION AND ACTIVITIES OF DAILY LIVING

At the time of follow up all patients were doing well, had returned to their preinjury activity level, and did not use walking aids. Hip and knee joint motion was measured using a goniometer. There were no functional impairments in hip or knee function except in those patients (seven) who suffered from slight degenerative joint disease. Their external/internal rotation, measured in a prone position, averaged 30° less (40°/20°) than the average range of rotation in

the remainder (60°/30°). Abduction/adduction, measured in a lateral decubitus position, did not differ between the patients with degenerative joint disease and those without (average 40°/30°, range 30–45°). Average hip flexion was 110° (range 100–130°), and knee flexion averaged 120° (range 90–130°). There had been no associated knee injuries.

DEGENERATIVE JOINT DISEASE, PAIN, SATISFACTION
Some 70% of the patients presented with occasional pain on a change in the weather but were generally satisfied with the treatment. Those patients with leg shortening and/or varus angulation showed some slight degenerative joint disease in the hip and knee joint which presented as pain on long distance walking and pain on onset, additionally showing radiographically slight subchondral osteosclerosis and/or osteophytes. Comminuted unstable fractures did not show any degenerative joint disease except for those with malalignment. There was also no difference between intertrochanteric and subtrochanteric fracture types or between the two groups of implants respectively.

REHABILITATION

The average stay in hospital amounted to 13 (range 10–22) days when the results for the one polytraumatised patient were included. Without the data for this patient the average stay was 12 days.

Time to bone healing was three months on average (range 10–20 weeks).

Length of sick leave was 14 weeks on average (range 8–20 weeks). Except for swimming and bicycling, sporting activity was begun an average of six months (range three to nine months) after surgery.

COMPLICATIONS (TABLE 3)

There was no delayed healing or non-union in this series. One patient developed an infection (2.4%) which healed after revision, insertion of gentamicin impregnated beads, and suction-rinse drainage.

Technical failures

There were three cases of plate loosening. One was due to inaccurate placement and the two others could be explained by attempting weight bearing too early.^{3–7} A change to implants with longer plates was necessary and healing then progressed uneventfully (table 3).

In two of the patients treated by Gamma nailing, malalignments occurred because the insertion of the nail was too medial and/or posterior.

In one patient, a haematoma had to be evacuated surgically. In another, a haematoma healed spontaneously.

Deep vein thrombosis and pulmonary emboli

No patient suffered from this complication in this series.^{8–11}

Postoperative mortality and morbidity

Except for the aforementioned patients with degenerative hip joint disease after malaligned fractures (n = 4), no major postoperative morbidity occurred.

Figure 2 Subtrochanteric fracture treated by insertion of a long Gamma nail, with varus and external rotation malalignment. (A) Before the operation; (B) after the operation; (C) two years after the operation.

Table 3 Complications (n = 6 (19%))

Age	Dg	First operation	Complication
32	A 3.1.	DHS+4-hole plate	Plate loosening→2nd Op : DHS+6-hole plate
54	A 2.1.	DHS+6-hole plate	Plate loosening→2nd Op : DHS+8-hole plate
42	A 1.1.	DHS+6-hole plate	Instability→2nd Op : DHS+8-hole plate
34	A 2.2.	DHS+4-hole plate	Haematoma revision
56	A 2.2.	Gamma	Spontaneous haematoma drainage
55	A 3.2.	Gamma	Infection→revision→uneventful healing

Dg, designation on fig 1; DHS, dynamic hip screw; Op, operation.

Discussion

This is a retrospective study of peritrochanteric sports related fractures in a population living in an alpine area and therefore well trained in the use of skis from the age of about three. Over the last 13 years, a modified skiing style and the fashionable craze of mimicking top athletes has brought about a change in fracture patterns not only in the peritrochanteric region.¹²⁻¹⁴ In addition, improved equipment and the development of skiing areas through installation of more ski lifts have allowed too many people on the slopes with an increased probability of crashes. Although the absolute number of fractures has decreased, the trend of the fracture pattern has changed towards high energy comminuted types complicated by soft tissue lesions similar to fracture patterns usually associated with traffic accidents.¹²⁻¹⁵ In this study, more than 50% of the patients had an average age of 42 (range 36–50) years, sustained their injury during skiing, and were living in the local area (fig 1A,B). The remainder of the fractures had occurred during downhill mountain biking, except for three which were toboggan accidents. The incidence in men was seven times higher than in women when compared with a “normal population group” of peritrochanteric fractures caused by a simple fall (ratio of women to men, 3:1; average age 79 and 70 years respectively).¹⁵ In a series of subtrochanteric fractures that were mostly due to traffic accidents, this ratio was reversed in favour of men having an average age of 46 years while women were 68 years old on average.¹⁵ Overall, the results in the present series were better than in other series in which the patients were aged above 60 and had osteoporosis.^{9 10 15-18 22}

A stable method along with the possibility of early weight bearing is required to prevent problems of bone healing and infections. In addition to the Arbeitsgemeinschaft für Osteosynthesefragen/Swiss Association for Internal Fixation (AO/ASIF) reconstruction nail, which is also now in use at our hospital, the Gamma nail provides such an implant.^{4 5 7-10 16-18 20 21} Several biomechanical studies found that the Gamma nail had major advantages over a sliding hip screw (DHS) or certain blade plates.^{17 19} In this study, no implant failure occurred and no other implant related stability problems were present. The only problem with this nail is the position of its tip in the middle of the diaphysis and similar stress peaks, as an uncemented shaft of a hip prosthesis has been reported.¹⁹ However, although cortical thickening around the tip of the nail was seen in nearly half of our patients, in neither of our series has any effect of this phe-

nomenon been observed. There was also no need to change it to a long Gamma nail.^{5 15 21 22} Furthermore, osteosynthesis implants of the hip are removed on average 18 months after the operation in active patients younger than 60 and those concerned about metal remaining in their body. The metal is also removed if there are any signs of loosening of the femoral neck screw of the Gamma nail or the DHS.

In this series, walking with either a frame or crutches was begun when the patient was able to get up with or without the aid of a nurse. The only problem of this device was the blood loss with subsequent local haematoma. As this is due to intramedullary reaming, it cannot be entirely avoided. Although the number of patients in this series is low, a significant difference was found in the operation time, blood loss, fall in haemoglobin level 48 hours after surgery, and replacement blood units required. With respect to the operation time, insertion of a Gamma nail required 39 minutes while a DHS was implanted in 27 minutes. On the other hand, blood loss was much less with implantation of a DHS (table 1). The latter may have been result of the extensive experience of the two surgeons, who had operated on nearly 400 patients with proximal femoral fractures.¹⁵ Except for medial or posterior insertion producing two cases of malalignment, no other technical complication was seen in this series.^{4-6 9 10 16 18 20 21}

Although closed soft tissue lesions were always present, general complications such as deep vein thrombosis did not occur. The high incidence reported in other studies may be explained by an elderly population group and a prevalence of polytraumatized patients.⁸⁻¹¹ As no special screening was carried out, some kind of “subclinical” deep vein thrombosis may have been overlooked. Although Röder *et al*¹¹ found bone marrow invasion sonographically after using the Gamma nail or the DHS, and recommended drilling a distal hole in the lateral femur cortex (marrow care relief), this procedure was not performed in the present series.

However, with the initial use of these devices (DHS in 1985, Gamma nail in 1992), complications during the operation had been more common with the Gamma nail.^{6 9 16 18 20} In contrast, a complication rate of up to 38.6% has now been reported for the DHS and its technique has been described as demanding.^{3-4 7 10 17 23} Finally, no major difference was found in wound complications, stay in hospital, or mobility at final review between the two treatments.^{4 8-10}

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Take home message

Implantation of either a DHS or a Gamma nail to treat a proximal femoral fracture will be of benefit provided that stability, vascularisation, proper reduction, and atraumatic technique are performed correctly. These essentials together with early mobilisation will hasten a patient's return to the activities of daily living.