Failure of short versus long cephalomedullary nail after intertrochanteric fractures

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ARTICLE INFO

Keywords:

Intertrochanteric fracture
Gamma nail
Intramedullary nail
Cephalomedullary nail
Hip fracture
Complication

ABSTRACT

The aim of study is to examine the frequency of reoperation and difference in failures for short cephalomedullary nail (SN) and long cephalomedullary nail (LN). We included patients with an intertrochanteric fracture treated with Gamma nail (Stryker®). All radiographs were reviewed, TAD and diastasis were measured, and type of failure registered. 216 patients were included, 95 short nails and 121 long nails. We found 12 reoperations, 5 in the SN group and 7 in the LN group. Most common failure was cut out. Our study showed no difference in frequency of reoperations or type of failures.

1. Introduction

All over the world the population is expanding, and the average life expectancy is rising. Hip fractures are a challenge because the morbidity and mortality are high and the economic burden is high and this group of patients is expected to increase due to the change in the population demographic.^{1–3} Trochanteric fractures account for almost half of all hip fractures and the amount of trochanteric fractures is expecting to increase more than the amount of cervical fracture.² Different classifications are used to classify intertrochanteric fractures, and best known are Evans and AO/OTA classification. Classifying the fracture are helpful when deciding if the fracture is stable or unstable. AO/OTA classification are widely used for intertrochanteric fractures and the classification describe the fracture pattern.⁴

The sliding hip screw have been the choice of treatment for all trochanteric fracture for many years. After the introduction of cephalomedullary nails, treatment of unstable intertrochanteric fractures has changed. Over the past decade the use of cephalomedullary nails are markedly increased.⁵ With the development and different designs of cephalomedullary nails, the discussion is now focusing on difference in risks and advances between short and long cephalomedullary nails when stabilising an unstable intertrochanteric fracture. Sliding hip screw are still first choice for stable trochanteric fractures.

Studies comparing short and long cephalomedullary nails in

treatment of intertrochanteric fracture focus on operation time, blood loss and fluoroscopy time and findings include a reduced operation time, fluoroscopy time and blood loss in the group treated with a short cephalomedullary nail compared to a long nail.^{6–9}

Cut out is a frequent failure for both extra- and intramedullary fixation of intertrochanteric fractures and influenced by the position of the collum screw in caput femoris. Tip apex distance (TAD) is the distance between the tip of the collum screw and the apex of caput measured in AP and lateral view on the radiograph. TAD was first introduced by Baumgartner, who showed that a TAD more than 25 mm were correlated to the risk of cut out.¹⁰ His study was based on the position of the sliding hip screw fixed in a plate, but later studies showed that TAD also affected the risk of cut out after intramedullary fixation.^{11,12}

The aim of this study was to compare the risk of failure for short cephalomedullary nail (SN) and long cephalomedullary nail (LN) and see if the types of failures were identical for the two types of nail.

2. Material and methods

The study is a retrospective cohort study. Data was collected retrospectively by identifying patients operated for an intertrochanteric fracture in the period 01-01-2012 to 31-12-2012 in five different hospitals in the southern part of Denmark.

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In Denmark, all patients admitted with a hip fracture are registered in Danish Multidisciplinary Hip Fracture Registry (DMHFR). Each person in Denmark has a unique central patient register number (CPR), which identify the patients in DMHFR. Patients with intertrochanteric fracture were identified based on the ICD 10 classification (WHO international classification) DS 72.0 Fracture of neck of femur, DS 72.1 Pertrochanteric fracture and DS 72.2 subtrochanteric fracture.

The diagnose was combined with the operative procedure code for internal fixation; KNFJ50 internal fixation with intramedullary nail in neck fractures, KNFJ51 internal fixation with intramedullary nail in intertrochanteric fracture and KNFJ52 internal fixation with intramedullary nail in subtrochanteric fractures. Inclusion criteria were intertrochanteric fracture treated with cephalomedullary nail. In the Southern part of Denmark, the Gamma 3 nail (Stryker, 2825 Airview Boulevard, Kalamazoo, MI 49002 USA) are almost exclusively used for intertrochanteric fractures in elderly patients with low energy fracture. Two nails are available, a short Gamma 3 Nail and a long Gamma 3 Nail.

Data registered for each patient included affected hip, gender, age and operation date. Reoperations after surgery for hip fractures are also registered in DMHFR and the data we received were for reoperations reported in a two year follow up period for all patients. If a patient sustained a hip fracture on the contralateral hip during the period for data collection each fracture was included individually.

All radiographs identified by the CPR number were examined. Patients were excluded if radiographs were not accessible, the fracture was not intertrochanteric or another implant than cephalomedullary nail were used.

Short and long Gamma 3 Nails were identified, and the patients were divided into two groups.

TAD was measured on all postoperative radiographs to estimate the position of the implant. The diameter of the lag screw was used in A/P and lateral view to adjust for the factor of magnification. Maximum diastasis in the fracture was measured on A/P and lateral view to qualify the reduction of the fracture.^{13,14} All fractures were classified according to AO classification.^{7,14,15}

The choice between long and short cephalomedullary nail was made by the surgeon who operated the patient. At some hospitals long cephalomedullary nail were used as standard for all types of intertrochanteric fractures. The patient was placed supine on a fracture table and the fracture reduced by open or closed manipulation, nail was inserted as prescribed in the operative guide. Postoperative care for hip fracture follows a national clinical guideline where all patients receive physiotherapy postoperatively during hospital stay securing early mobilization. All patients received thrombosis prophylaxis postoperatively and the haemoglobin level was used to evaluate need for blood transfusion. There was no routine follow-up in outpatient-clinic.

For patients with complications leading to reoperation medical records and radiographs were examined for type of failure and secondary surgery performed. Causes of failure were divided into seven groups; Cut out, ipsilateral fracture, non-union, implant failure, infection, pain/discomfort caused by the implant and unspecified. Cut out is defined as the collum screw penetrating the joint line in the femoral head and migrating proximal. Ipsilateral fracture is defined as a new fracture in relation to the implant. Non-union is defined as insufficient healing of the fracture leading to reoperation.

Descriptive analysis was carried out with 95% confidential interval. Student's T test and chi² test were performed.

3. Results

250 patients met the criteria with femoral neck fracture, intertrochanteric fracture or subtrochanteric fracture in combination with operative procedure codes for internal fixation with intramedullary nail in DMHFR. Radiographs for all patients were examined. 38 patients were excluded because of the fracture, another treatment than

Table 1

Demographics, TAD and diastasis in both groups.

	SN	LN	
Patients (N)	95	121	
Age, years mean (SD)	83.1 (8.35)	82.9 (7.69)	P = 0.884
Sex (M/F)	28/67	43/78	P = 0.346
TAD, mm	18.67 (6.95)	17.88 (5.81)	P = 0.997
Mean (SD)			
Diastasis, mm	5.98 (5.82)	7.26 (7.95)	P = 0.630
Mean, (SD)			

Table 2

Type of failures for both groups.

	SN	LN
Cut out	3	3
Ipsilateral fracture	1	1
Implant failure	0	0
Non-union	0	1
Infection	0	0
Complaints related to implant	0	1
Other/unknown	1	1

cephalomedullary nail or missing radiographs. In total 216 patients were included, 95 SN and 121 LN.

There was no difference in demographics between the two groups (Table 1). There was no difference in TAD and diastasis between the two groups as well (Table 1). In the SN group 5 patients had a failure within the first two years, while 7 patients with LN had a failure ($p = 0.868$). The causes of failure were similar in the two groups (Table 2). The ipsilateral fracture in the group with SN was a hairline fracture seen in the postoperative radiograph and the fracture was believed to be iatrogenic. The ipsilateral fracture in the LN group was caused by a subsequently fall. Two patients had total hip replacement because of osteoarthritis and avascular necrosis observed before primary surgery. For the patient with complaints from the hip there was no displacement of the implant or prominence of the collum screw.

In Table 3 the TAD, diastasis and classification are shown for the patients with cut out. In the LN group 2 patients had a TAD more than 25 mm, while the TAD in the SN group was less than 25 mm. Most of the fractures were A3 fractures. Fig. 1 shows the fractures classified according to the AO classification. LN were more often used to treat comminute fractures and invers intertrochanteric fracture, but all types of fracture were managed with both types of nails.

4. Discussion

We did not find a higher risk of reoperation in patients with a SN compared to a LN. The indications for reoperation were the same in the two groups.

A randomised study from 2002 compare standard Gamma Nail (first generation) and The Proximal Femoral Nail (PFN) (Synthes GmbH Eimattstrasse 3, 4436 Oberdorf, Switzerland) and found no difference in cut out with 6.6% and 6.9%, but more fractures after a second fall with 0.5% for Gamma Nail and 4% for PFN.¹⁶ Another study from 2002

Table 3

Patients with cut out.

Patient	Nail	TAD (mm)	Classification	Diastasis (mm)
1.	SN	16.2	A2.3	3.2
2.	SN	19.7	A3.2	19.7
3.	SN	20.9	A1.2	5.6
4.	LN	23.6	A3.2	19
5.	LN	30.1	A3.1	6
6.	LN	37.1	A3.1	0

Fig. 1. AO Classification of all fractures.

found higher risk of a second fracture after gamma nail (first generation) compared with sliding hip screw.¹⁷ Later studies with second and third generations Gamma Nails show no difference in risk of reoperation and ipsilateral fractures when comparing long and short cephalomedullary nails.^{6–9,18,19}

In previous studies the comparison between short and long cephalomedullary nails focused on blood loss perioperative, time in theatre and cut out, but early and later studies do also compare complications for short and long cephalomedullary nails. A systematic review from 2017²⁰ comparing short and long intramedullary nails for OTA A1, A2 and A3 trochanteric fractures included 10 studies and their meta-analysis showed no difference in risk of complications, but supports the findings with reduced blood loss and time in theatre. In our study all patients were operated with third generation Gamma Nail. 5,2% of the patients with SN in our study were reoperated compared to 5,7% of the patients with LN. The incidence of a second fracture was 1% for SN and 0,8% for LN. Our results are in line with published results in both retrospective and prospective studies showing no difference in risk of reoperation and ipsilateral fractures when comparing long and short third generation cephalomedullary nails.^{6–9,18} A higher risk of ipsilateral fracture were found using PFN compared to Gamma nail and when comparing gamma nails with sliding hip screw.^{16,17} Those studies are from 2002 and therefore the Gamma Nails used were first and second generation. The development in short Gamma nail which was a reduction in length and only one locking screw to reduce stress distally could be one of the reasons for fewer ipsilateral fractures observed in later studies as in this one.

Diastasis and TAD were measured to compare the reposition of the fracture and position of the implant and we did not find a difference in our two groups. In our study we had to few reoperations with cut out to conclude if TAD or diastasis influence the risk of reoperation. We had 6 patients with cut out which is shown to be the most frequent failure leading to reoperation. Andruszkow et al. compared DHS with Gamma Nails in a study from 2012¹² and found a higher risk of cut out when TAD was more than 25 mm for both gamma nails and DHS. A systematic review from 2013 including both extra- and intramedullary fixation also supports the relation between TAD and cut out.¹¹ Both extra- and intramedullary fixation were included in that review. Mingo-Robinet et al. compared stable with unstable intertrochanteric fractures and found a higher risk of cut out for unstable fractures than for stable fractures, but TAD did not influence on the risk of cut out.¹⁴ In our study all patients with cut out had unstable A3 fractures, but the number of patients were too small to conclude any relation between

nature of the fracture and cut out.

Our study has limitations. In this study all radiographs were examined, which make sure all patients in the study had intertrochanteric fractures treated with cephalomedullary nail. But the study was retrospective, and the choice of implant was chosen by the surgeon performing the surgery except for one department which routinely used LN.

SN were more often used in fractures classified as stable. A sliding hip screw could also be the choice of treatment for some of those intertrochanteric fractures, which in part could explain the higher number of patients in the LN group. Infections were not observed, so it must be suspected, that infections were not correctly reported in the database. Only medical journals from patients with reported reoperations were examined.

5. Conclusion

The risk of failure after intertrochanteric fracture with cephalomedullary nail is low. We did not find a higher risk of failure for short cephalomedullary nails, than for long cephalomedullary nails. The Causes of failure were the same in the two groups and our study is too small to find a possible difference in types of failures.

Funding

No sponsor has been involved in this study. No funding has been received.

Author's contributions

PB was responsible for conception and design, collecting data and wrote first draft of the manuscript and revised it.

ML contributed to conception and design, revised the manuscript critically and approved the submitted manuscript.

CM supported the conception of the study, revised the manuscript critically and approved the submitted manuscript.

JS supported the conception, of the study, revised the manuscript critically and approved the submitted manuscript.

Declarations of competing interest

None.

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