Original Research Article

Intramedullary Hip Screw (IMHS) for the Treatment of Intertrochanteric Hip Fracture: A Retrospective Study

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Abstract

Background: Intramedullary hip screw (IMHS) is a cephalomedullary nail used for surgical treatment of hip fracture for the past two decades but only a few studies have been reported.
Aim of the study: To evaluate the effectiveness of IMHS for intertrochanteric fracture in Thammasat university hospital.
Materials and methods: Ninety-two intertrochanteric fracture patients were retrospectively reviewed.
Results: Mean operative time was 87 minutes (45-154 min) with an average blood loss of 150 ml (50-300 ml). Intraoperative femoral shaft fracture was found in two cases which required the immediate exchange to long IMHS intraoperatively. One displaced large greater tuberosity fragment during nail insertion was treated by tension band wiring and five lateral cortex fractures were managed conservatively. Failed IMHS were found in 3 cases with two cases screw cut out the femoral head and one fracture extending from intertrochanter to the superior neck. All of these three cases were changed to hip prosthesis. Most of the patients stayed in the hospital for 3 weeks (61.4%), younger patients tend to have shorter hospital stay (<1 week) and preexisting medical complications may prolong hospitalization (>1 month). From this study, IMSH can safely treat a hip fracture patient and

its complications can be avoided by correct entry point, over-reaming and manually pushing the nail with use of a hammer and a centering sleeve.
Conclusion: IMSH is a choice of treatment for hip fracture in Thais with a satisfactory outcome, and complications can be avoided by locating the correct entry point, over-reaming and manually push the nail while using a hammer and a centering sleeve.

Key words

Intramedullary hip screw, IMHS, Cephalomedullary nail, Intertrochanteric fracture, Hip fracture.

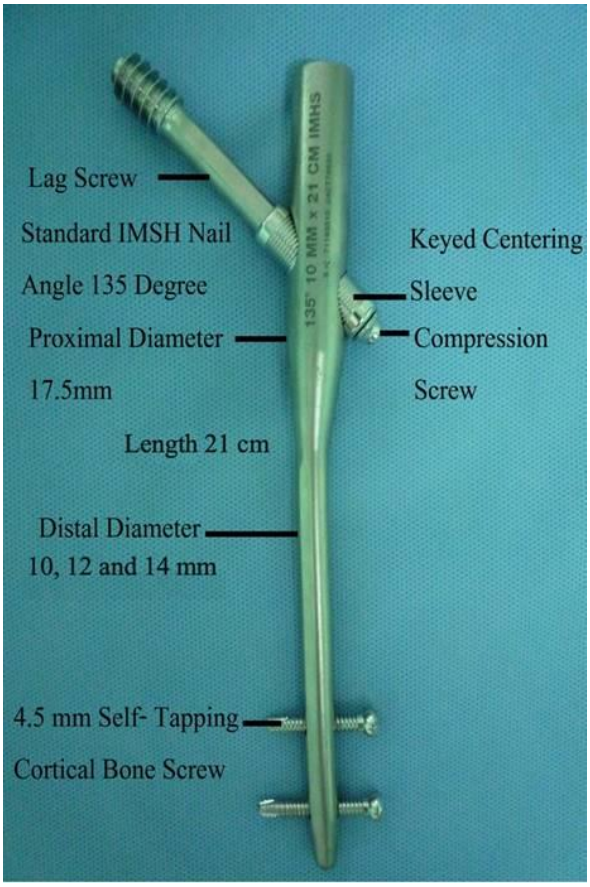
Introduction

"Hip fracture" is an important health problem, because the incidence is high and there is a high rate of morbidity and mortality. Death and financial cost after osteoporotic hip fracture in the elderly is a major health problem in Thailand. Mortality rate is about 18% during the first year after hip fracture. It is extremely high and is about 8 times higher than that in the age-adjusted general population [1]. In a study in Thailand, the incidence of hip fracture was up to 80% in patients aged over 70 years and occurred in 70% in women. In all men and women aged over 84 years the age-adjusted incidence of hip fracture had increased 2-fold from 657 per 100,000 per year in 1997 [2] to 1,239 per year in 2006 [3]. Men were found to be at an increased risk of dying compared to women. Studies show that Thai patients who do not receive surgery have almost double the risk of dying post hip fracture [4]. About half of the incidence of hip fracture is intertrochanteric fracture [5].

Intertrochanteric fracture treated by operation with internal fixation, results in more superior outcomes than nonoperative treatment [6]. Internal fastening is the standard treatment method for trochanteric fracture, developed from the pin, to sliding plate and interlocking nail.

Intramedullary hip screw (IMHS; Smith and Nephew Richards, Memphis, TN, USA) in **Figure - 1** is an intramedullary implant. During the past two decades, a study comparing intramedullary hip screw and sliding hip screw showed the biomechanical advantage of intramedullary hip screw in terms of stability, minimal surgical exposure and limited fracture collapse especially in reverse oblique fracture and subtrochanteric extension [7].

Figure – 1: Intramedullary hip screw (IMHS; Smith and Nephew, Richards, Memphis, Tennessee, USA).



Although IMSH has been available since 1998 and compared with other implants e.g. Gamma nail or Proximal femoral nail, only few studies have been reported in the literature.

The objective of this study is to evaluate the effectiveness of IMSH for intertrochanteric fracture and is designed as retrospective study.

Materials and methods

Between January 2003 and August 2009 ninety two intertrochanteric fracture patients were treated by IMSH in Thammasat University Hospital (Level 1 Trauma Center). Clinical records and radiographs were reviewed. There were 43 males and 49 females with mean age 73.1 ± 18.4 years. There were 81 patients in low energy mechanism group with mean age 79.2 ± 10.9 years and 11 patients in high energy mechanism from traffic accident with mean age 31.1 ± 5.4 years as in **Table - 1.**

Table – 1: Patient demographic data.

Pt (n)	92
Sex (M / F)	43 : 49
Mechanism (low/high)	81 : 11
Total mean age (years)	73.1 ± 18.4
Mean age in low mechanism (years)	79.2 ± 10.9
Mean age in high mechanism (years)	31.1 ± 5.4
Mobility score	7.5 ± 2.2

According to Evan fracture classification [8] in **Figure - 2**, there were 21 patients in stable fracture and 71 patients with unstable fracture (there are 65 patients in Evan I unstable group, 3 patients in Evan II group and 3 patients in subtrochanteric extension group in **Table - 2**).

Mobility score [9] is used to evaluate preoperative and postoperative functional status of the patients in **Table - 3**.

IMHS is a cannulated intramedullary nail which is anatomically designed with a 4° mediolateral bend and 2.0 meter radius of curvature to allow the insertion to the greater trochanter and reduce anterior cortex impingement. This nail is used with standard lag screw insert into femoral head and 4.5 mm distal lock diameter, lag screw can slide within a barrel enhance proximal fragment slide to distal fragment. Standard IMHS lag screw 135 angles are used in all cases and in three diameters (10 mm, 12 mm and 14 mm) and proximal diameter of 17.5 mm. Short nail is 21 cm in length allowing extension beyond subtrochanteric region. Long IMHS nails are available (32, 34, 36, 38, 40 cm) and are indicated in subtrochanteric fractures extended to femoral shaft.

Table – 2: Patient characteristic according to Evan fracture classification.

Type	**Evan I**		**Evan I**	**Subtrochanteric extension**
	stable	**stable**		
N	21	75	3	3

Figure – 2: Evan fracture classification.

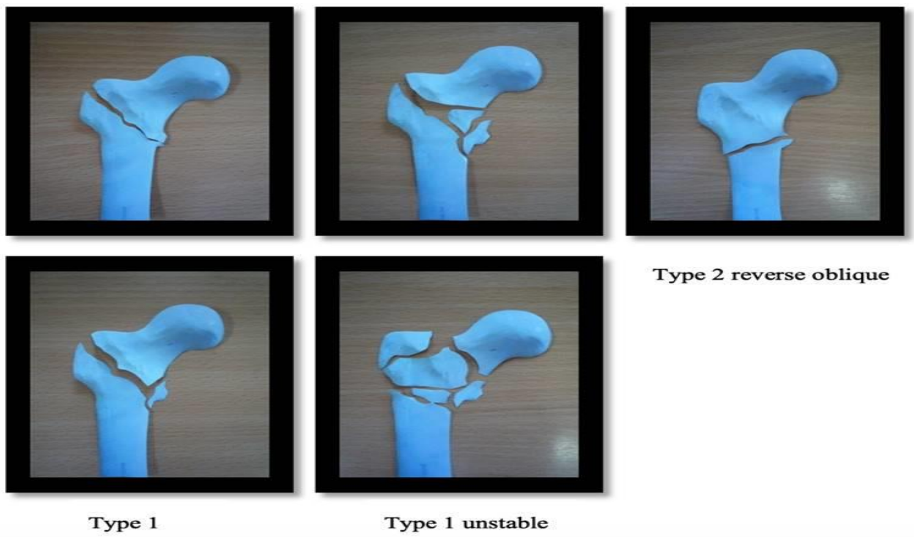


Table – 3: Assessment of Mobility score (Score is the total, 0 to 9).

Mobility	No difficulty	With an aid	With help from another person	Not at all
Able to get about the house	3	2	1	0
Able to get out of the house	3	2	1	0
Able to go shopping	3	2	1	0

Surgical technique

After anesthesia, the patients are placed in supine position on fracture table. Distal femoral traction is performed on the affected side. We routinely use distal femoral traction because it is easy to perform reduction especially in flexed proximal fragment which requires flexion of the distal to match with. Moreover, it can provide rigid and stable reduction during operation.

The reduction is performed by adduction, slight traction by lengthening the fracture table arm and internal rotation by adjusting the angle of distal femoral pin that connected with the fracture table. The patient's trunk is tilted toward the unaffected side to allow access to greater trochanter and stabilize the trunk. Intravenous antibiotic prophylaxis using Cefazolin 1 g is administered 30 min prior to operation in all patients.

A small incision is made over the tip of the greater trochanter. The awl is placed at the greater trochanter, the position of the entry point is confirmed by fluoroscope in AP and lateral view. The 3.2 mm guide wire is passed from the tip of the greater trochanter to the femoral canal. The entry point is enlarged by 11 mm cannulated drill. Then the femoral canal is reamed with a flexible reamer. The proximal part of the femur is reamed to 17 mm to accommodate the proximal nail diameter. The nail is inserted by hand without using a hammer. Once the nail is seated, the targeting device is used to insert a guide pin is advanced into the femoral head through stab incision. Correct length of pin is measured. Screw is placed in the both center of the head or slightly inferiorly within 5 to 10 mm of subchondral border. Distal locking screws are placed through the sleeve that is attached to the radiolucent drill guide.

73 patients had received spinal anesthesia and 19 patients had received general anesthesia. All patients were operated on fracture table and attempted closed reduction under fluoroscopic prior to skin incision being made. The aim is to place lag screw position in the center of femoral head and neck in both AP and lateral view and tip of lag screw within 5-10 mm from subchondral bone. All patients are treated with IMHS lag screw 135 angles with different diameter according to their femoral canal size.

On the first day post-operation, all patients are ambulated by sitting bedside and encouraged to perform quadriceps muscle-strengthening exercises. Operative time, intraoperative blood loss, intraoperative and postoperative complications, length of hospital stay and follow up time are recorded.

After discharge, all patients are appointed in outpatient's clinic at 2 weeks, 6 weeks, 3 months, 6 months and 1 year. Routine postoperative wound care, radiographic evaluation was obtained. Functional status is evaluated using mobility score at 1 year postoperative compared with preoperative status.

Results

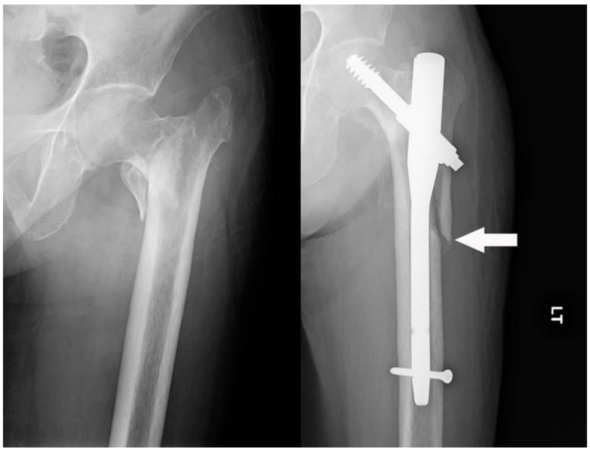
The mean operative time was 87 minutes (45 to154 min). The average blood loss was 150 ml (50 to 300 ml) in **Table - 4.** The intraoperative complications were displaced fragment of greater trochanter during nail insertion in four cases, but did not affect the stability in 3 cases. One case is displaced large fragment of greater tuberosity with 1 cm displacement during nail insertion treated by tension band wiring in **Figure - 3**. Two femoral shaft fractures were treated by immediate exchange to long IMSH intraoperatively. Five lateral cortex fractures were managed conservatively in **Figure - 4.** Proximal screw dislodges in two cases were managed by reinserting the screw in **Figure - 5.** Failed IMHS was found 3 cases, one in fractured intertrochanteric femur extending to superior neck in **Figure - 6**. The hip screw cut out the femoral head in two cases in **Figure - 7,** all of these change to hip prosthesis and one of them had infection which require debridement with antibiotic beads prior to hip prosthesis. There was one case of surgical site infection which require debridement and intravenous antibiotic. One persistent hip pain required NSAIDs and analgesia drugs and remove implant after fracture consolidation in **Figure - 8**.

<u>Table – 4</u>: Perioperative data.

Anesthesia	General: 19, Regional: 73
Operative time (mean)	87 ± 14.2 min (45-154 min)
Blood loss	152 ± 69.6 ml (50-300 ml)
Complication	13 cases (displace greater tuberosity 4 cases, femoral shaft fracture 2 cases, Lateral cortex fracture 5 cases, proximal screw dislodge 2 cases

<u>Figure – 3</u>: Displacement of greater tuberosity during IMSH insertion treated by tension band wiring.

<u>Figure – 4</u>: Fracture of the lateral cortex (Arrow) during IMSH insertion.



<u>Figure – 5</u>: Dislodged proximal screw initial fracture.

<u>Figure – 6</u>: Failure of IMSH in cervico-trochanteric fracture treated by total hip arthroplasty.

<u>Figure – 7</u>: Hip screw cut out during period of follow up.

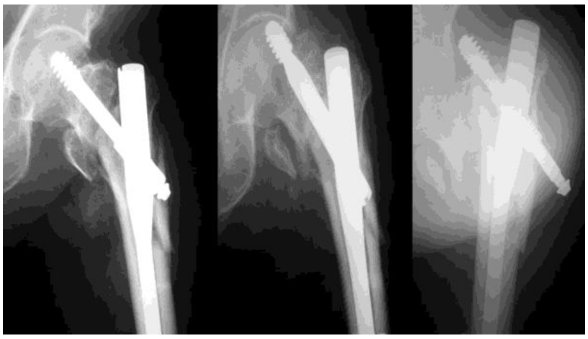


Figure – 8: Hip pain from prominent IMSH: after removing the IMSH, the symptom disappeared.

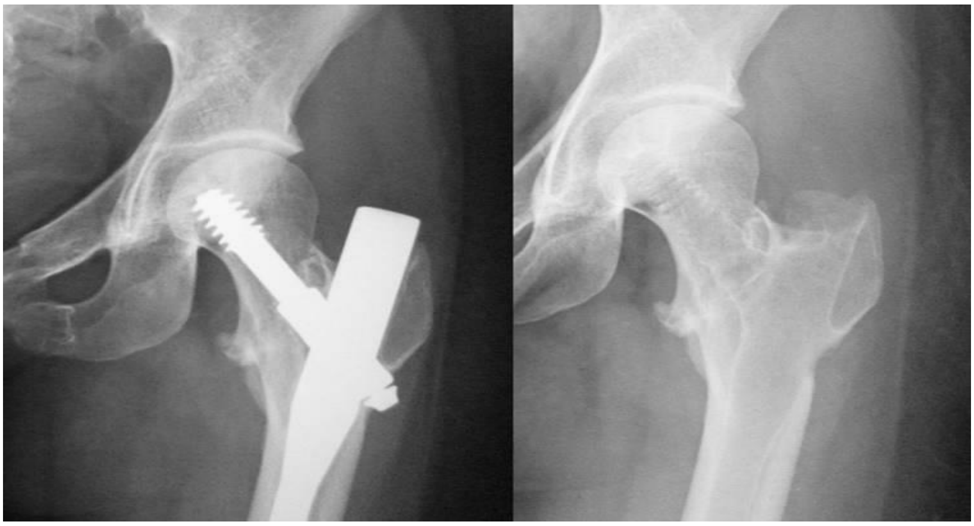


Figure – 9: Frequency of nail diameter.

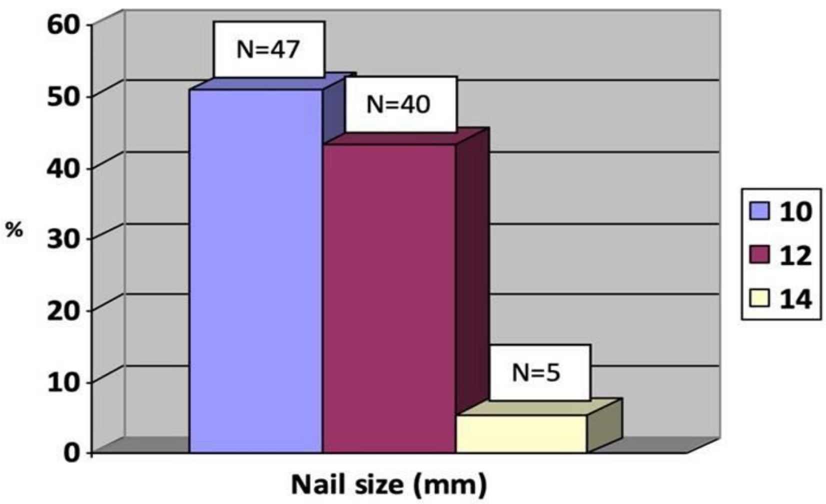


Figure – 10: Frequency of length of lag screw.

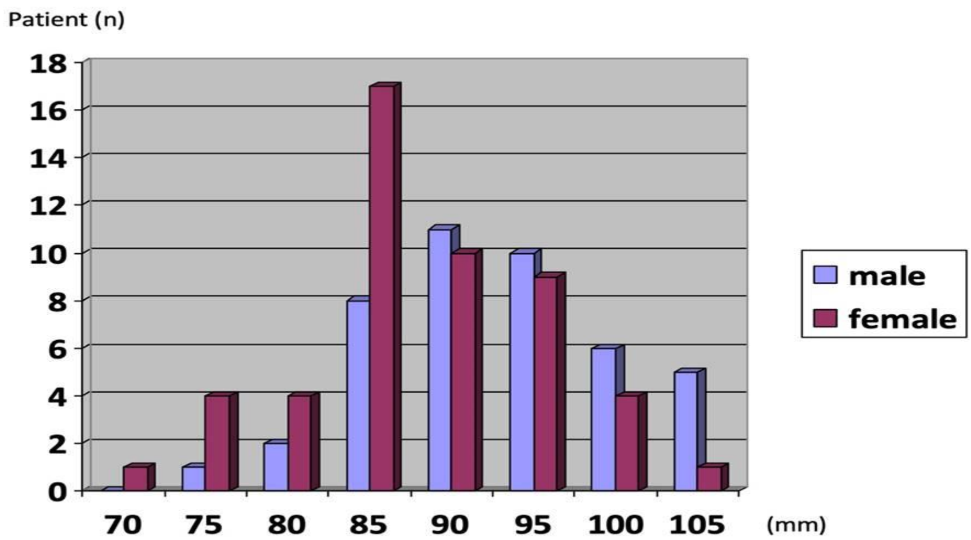


Figure – 11: Good results for IMSH in the treatment of stable (A) and unstable (B) intertrochanteric fracture.

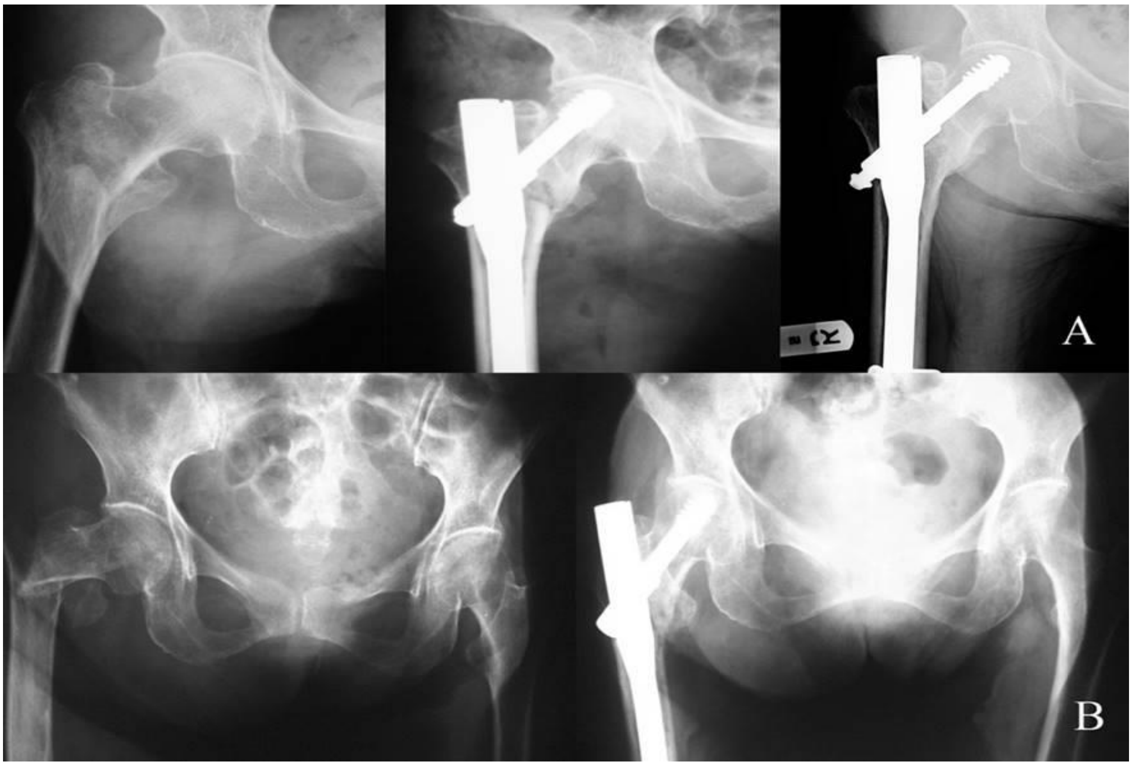
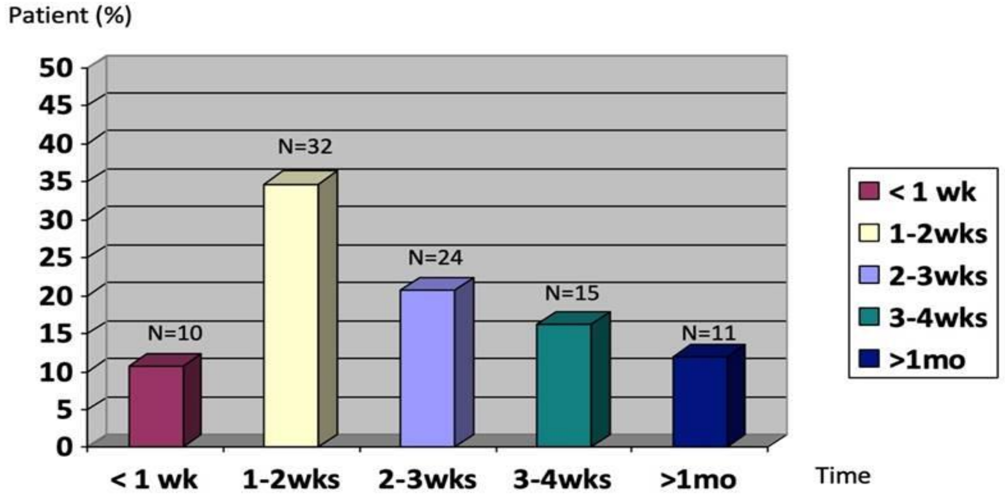


Figure – 12: Length of hospital stay for intertrochanteric fracture patients in Thammasat University Hospital between 2003-2009.



The common medical postoperative complications were delirium (13%), urinary tract infection (9.7%) and respiratory tract infection (3.2%). In our series, we did not find deep vein thrombosis. Frequency of nail diameter in **Figure - 9** and length of lag screw in **Figure - 10** were recorded.

Most of the patients stayed in hospital for 3 weeks (61.4%). The short periods group (less than 1 week) were the young-aged patients and the longest group (more than 1 month) was the 11.9 % with preexisting medical complications.

Figure – 13: Last follow-up time of the patient with an intertrochanteric fracture of the femur in Thammasat University Hospital from 2003-2009.

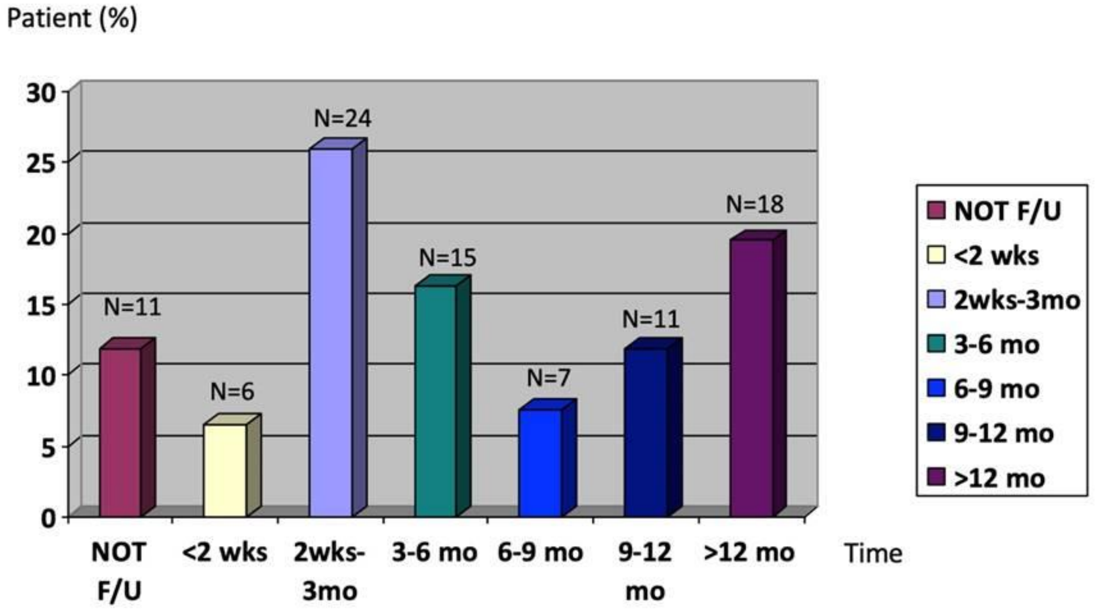
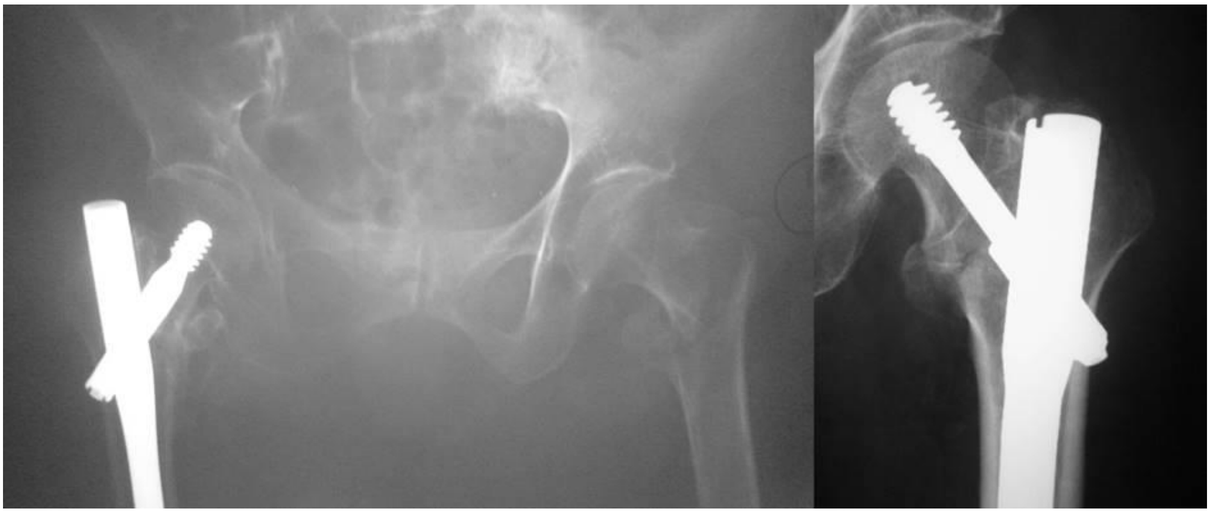


Figure – 14: Bilateral intertrochanteric fracture: the previous fracture was treated by Gamma nail.



Discussion

Rising incidence of hip fracture in Thais [10] have been widely and acceptably treated with internal fixation in order to minimize fracture complication. This study has documented the ability of IMSH to treat hip fracture in Thais both stable and unstable fracture configurations, as in **Figure - 11**. Common nail diameters are 10 and 12 mm and proximal screw size 85 mm in females and between 90-95 mm in males. Mean operative time is 87 min which is slightly higher than previous studies (67 and 71 min, Baumgaertner [11] and Hardy [12] respectively). Mean intraoperative blood loss is 152 ml which is lower than that recorded by Baumgaertner and Hardy (245 and 198 ml respectively). Prolonged operative time mostly occurred under recently-graduated orthopedist.

From current study, intraoperative complication was mostly found in less experienced surgeons which can be preventable. Displaced fracture greater tuberosity or femoral shaft fracture can be caused by incorrect entry point in difficult obese patients or inadequate adduction push entry point laterally in to fracture site. Reaming using side-cut can cause additional fracture displacement and also unnecessary reaming of lateral cortex. This common complication can be prevented by setting patient in adequate adduction and using sharp awl to precisely identify entry point and open the femoral canal with large front-cut reamer to prevent further fracture displacement or initially using a guide pin followed by a large cannulated drill to open the femoral canal in the same manner as the new generation of trochanteric nail. Femoral shaft fracture is usually caused by using a hammer while the distal nail end abuts against the medial cortex. Femoral shaft fracture can also be prevented by over- reaming 1.5-2 mm and manually inserting the nail, then holding the nail in abduction direction after the nail abuts against the medial cortex or by increasing femoral adduction which can easily be applied if using distal femoral traction.

Lateral cortex fracture can occur if width and depth of reaming is inadequate and also hammering of centering sleeve is excessive. This can be prevented without using the hammer but carefully insert nail under fluoroscopy. Dislodgement of the proximal screw was found in high fracture close to cervicotrochanteric area making it difficult to obtain good reduction, resulting in poor screw position and purchase of the screw. Anatomical reduction is the key and careful insertion of the nail.

Medical complication such as delirium, urinary tract infection and respiratory tract complication was found to be related with advanced age but no deep vein thrombosis was observed in any patients.

Length of hospital stay is related to age, associated injury and complications. The majority of the patients were admitted for 1-2 weeks (34.7%) and 2-3 weeks (26.7%) as in **Figure - 12** with median age of 81.6 years in these groups. From the current study, we found that need for preoperative evaluation and postoperative rehabilitation were the main reasons for prolonged hospital stay. Patients admitted for less than 1 week was 10.8% in young patients (mean age 39.9 years) without comorbidity and ambulatory problems. Lastly, patients admitted for more than a month was 11.9% usually having medical complications.

Most patients were followed-up between 2 weeks and 3 months in 23.68% cases, secondly 3-6 months in 13.16% and more than 12 months in 17.71%. Loss to follow-up reason was that the patient and relatives paid more attention to other medical conditions after patient began partial weight-bearing ambulation, and chose to mainly follow-up chronic medical illness e.g. chronic renal disease, old ischemic stroke, heart disease and endocrine disease e.g. diabetes mellitus and dyslipidemia.

We found that patients who follow-up later than 3 months was only 31.31% due to difficulty in transfer or different visiting dates in multiple departments which caused them to choose only the more problematic condition.

Patients following-up after more than 12 months, mostly did not come to follow-up hip fracture but because of a new or preexisting spinal stenosis or osteoarthritis of the knee (**Figure – 13**).

Patients who could not follow-up within 2 weeks was 19.66% because of the need to return home in distant regions and convenience to follow-up at a nearby hospital or registered hospital.

The one-year mortality rate in the current study was 12 patients (13.04%) with mean age 94.6 years which is more than mean age (75.9) by 18.7 years. Advanced age is related to mortality rate, comparable to a previous study [13].

Radiographic union was found to be 100% in patients who followed-up later than 3 months (55.43%). On the other hand, mobility score is evaluated by phone interview in patients who failed to follow-up (44.57%). Half of the patients (36 patients) were able to return to walking as their preinjury status (Preoperative mobility score = Postoperative mobility score). Mobility score 7-9 recorded in 28 patients and mobility score 4-6 in 8 patients. Mean preoperative mobility score = 7.5 ± 2.2. Mean postoperative mobility score = 6.3 ± 2.9. Mean change in mobility score = 1.2. No significant difference showed after analysis using a paired t-test, so IMSH can safely treat a patient who suffers from a hip fracture.

From the current study, we realized that a hip fracture patient was abandoned in order to treat underlying osteoporosis and the focus was only on medical comorbidity which resulted in the recurrent contralateral hip fracture in **Figure - 14.** Physicians should emphatically explain and instruct (regarding the cause and risk of hip fracture) to all patients and their relatives to minimize hip fractures in the future.

Conclusion

In conclusion, IMSH is a choice of treatment for hip fracture in Thais with a satisfactory outcome, and complications can be avoided by locating the correct entry point, over-reaming and manually push the nail while using a hammer and a centering sleeve.

Acknowledgements

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