

SURGICAL TREATMENT OF PATIENTS WITH
DISPLACED FEMORAL NECK FRACTURES --
COMPARISON OF PRIMARY TOTAL HIP REPLACEMENT
WITH SECONDARY TOTAL HIP REPLACEMENT AFTER
FAILED INTERNAL FIXATION.

Abstract:

The optimal treatment for patients with femoral neck fractures, i.e. internal fixation (IF), hemiarthroplasty (HA) or total hip replacement (THR), should be based on the individual patient's age, functional demands and risk profile.

IF is uncontroversial in the treatment of undisplaced (Garden I and II) femoral neck fractures and good results regarding fracture healing, function and the health-related quality of life (HRQoL) can be expected. IF is also the method of choice in young patients with displaced fractures (Garden III and IV) and in patients not medically fit for an arthroplasty.

Recent randomised controlled trials (RCTs) have shown that a primary THR is superior to IF in the relatively healthy, elderly patient with a displaced femoral neck fracture during the first two years after the operation. There are few published reports on the outcome in a longer time perspective. Despite the good results for THR in this patient group, a vast majority of orthopaedic surgeons prefer HA instead of THR. Furthermore, in spite of the high failure rate for IF, the method is still recommended for this patient cohort by some authors. One argument is that if IF fails, there is always the possibility of performing a secondary salvage THR.

In an RCT with a four-year follow-up period, elderly patients with an acute displaced femoral neck fracture were randomly allocated to THR or IF. The results confirm that a primary THR, compared to IF, provides a better outcome. The complication and reoperation rates were significantly lower and the outcome regarding hip function was good, even in this longer time perspective. In a prospective trial with a two-year follow-up period elderly patients treated for an acute displaced femoral neck fracture were included. The outcome for patients with a primary THR was compared with the outcome for patients treated with a secondary THR after failed IF. Hip function was significantly better in the primary THR group and patients with failed IF later undergoing a secondary THR experienced a significant decrease in HRQoL during the first year of treatment compared with patients in the primary THR group.

The overall conclusion of the thesis is that THR can be recommended as the primary treatment for the relatively healthy, active and lucid elderly patient with a displaced femoral neck fracture. Bipolar HA can be recommended for the most elderly patients with lower functional demands.

INTRODUCTION

A hip fracture, especially a displaced femoral neck fracture, is probably the most devastating consequence of osteoporosis in the increasing elderly population and a major challenge for health care and society. In the year 2050 6.3 million annual hip fractures are expected to occur worldwide.¹

Femoral neck fractures constitute approximately 50% of all hip fractures and 70-75% of the femoral neck fractures are displaced (Garden III and IV).² The population of elderly patients with femoral neck fractures comprises several subpopulations, ranging from the lucid, relatively healthy, active and independently living patient with a long life expectancy to the institutionalised, cognitively impaired and bedridden patient with a substantially shorter life expectancy. There are several treatment modalities for patients with femoral neck fractures, i.e. internal fixation (IF), hemiarthroplasty (HA, unipolar or bipolar) and total hip replacement (THR), each treatment modality having its unique characteristics, advantages and disadvantages.

Internal fixation is uncontroversial in the treatment of undisplaced (Garden I and II)^{2,3} femoral neck fractures. Among patients with undisplaced fractures, the rate of fracture healing complications after IF is in the range of 5-10%⁴ in most studies with good results regarding function and the health-related quality of life (HRQoL).^{4,5} IF is also the method of choice in young patients with displaced fractures. The rate of fracture healing complications in the younger age group has been less well reported. However, due to these patients having longer life expectancy and consequently higher risk of revision surgery after an arthroplasty, IF is the preferred method. Most previous studies have used 65–70 years as the lower age limit for arthroplasty, i.e. the upper limit for IF, in patients with displaced fractures,⁶⁻¹⁰ but the optimal age limit is pending.

Recently, age 55 has been suggested to be the lower limit for THR.¹¹

Among patients with displaced fractures, the rate of fracture-healing complications after IF is considerably higher, being, in most studies with an at least two-year follow-up, in the range of 35-50%.^{4,6-12} Moreover, many patients experience impaired hip function and a reduced HRQoL despite an uneventfully healed fracture.^{5,13,14}

The alternative treatment is a primary hip arthroplasty, unipolar HA, bipolar HA or THR. In a recently published international survey of the operative management of displaced femoral neck fractures in elderly patients, there was some consensus that younger patients should be treated with internal fixation and older patients with arthroplasty. The preferred method for the most elderly was HA, unipolar or bipolar, but there was significant disagreement regarding the optimal approach to the management of the active elderly patients between 60 and 80 years of age.³ Some of the remaining controversies regarding the optimal treatment for the vast majority of the elderly patients may be partly explained by the long-lasting ambition to find a single surgical method to treat all patients with a displaced fracture of the femoral neck. Therefore, many of the previous studies have included a broad spectrum of patients of varying age with differing functional levels and risk profiles in order to be able to present results that can be generalised to the entire population of patients with displaced femoral neck fractures.

However, the surgical treatment of displaced femoral neck fractures differs from the treatment of many other hip fractures because the available treatment modalities, IF, HA and THR, differ regarding surgical impact, complications and the long-term outcome. There is a growing opinion that the treatment of patients with displaced femoral neck fractures should be individualised, i.e.

should include all available surgical options and be based on the individual patient's age, functional demands and risk profile.^{4,15} Therefore, future trials should be under taken to identify groups of patients who would be better treated by any of the surgical methods available.¹⁵

The primary aim of this thesis was to evaluate and compare primary total hip replacement with secondary hip replacement after failed internal fixation for the relatively healthy, active and independently living patient with a displaced femoral neck fracture.

MATERIALS AND METHODS

ETHICS

All patients gave their informed consent to participate.

AGE AND GENDER

Patients aged 70 or older were included. In our study the mean age was 80 years with 89% being female patients.

Eighty-four patients with a THR after an acute displaced femoral neck fracture were included

Forty-three patients with a primary THR and forty one patients with a secondary THR after failed IF after a displaced femoral neck were included.

All patients satisfied the same inclusion criteria before the primary operation,

- a displaced femoral neck fracture (Garden III and IV),
- age \geq 70 years
- absence of severe cognitive dysfunction
- independent living status and
- independent walking.

Patients with pathological fractures, displaced fractures older than 24 hours and patients with RA or OA were not included.

Follow-up was performed at 24 months after the THR.

PATIENT MOBILITY

All patients included had independent walking capability with or without a walking aids before the fracture.

HIP FUNCTION

In our study we compared the outcome after IF and different types of hip arthroplastie,s. Charnley's classification ³² was used to assess hip function.

Charnley's numerical classification ³² defines the clinical state of the affected hip joint in three dimensions: pain, movement and walking ability.

Each dimension is graded from 1 to 6, with 1 = total disability and 6 = normal state (Table below).

CHARNLEY'S NUMERICAL CLASSIFICATION

GRADE	PAIN	MOVEMENT	WALKING
1	Severe and spontaneous	0-30 ⁰	Few meters or bedridden
2	Sever on attempting to walk, prevents all activity	60 ⁰	Time and distance very limited with or without walking aids
3	Tolerable, permitting limited activity	100 ⁰	Limited with walking aids, difficult without, able to stand long periods
4	Only after some activity, disappears quickly with rest	160 ⁰	Long distance with walking aids, limited without
5	Slight or intermittent, pain on starting to walk, but gets less with normal activity	210 ⁰	No walking aids, walks with limp
6	No pain	260 ⁰	normal

SURGICAL PROCEDURES:

HIP REPLACEMENT

Hip replacement was carried out using an anterolateral approach, a modified Hardinge approach,³⁹ with the patient in the lateral decubitus position.

The THR used in our Study was the modular Exeter-stem (Stryker Howmedica, Sweden) with a 28-mm head and an OGEE® acetabular component (dePuy/Johnson-Johnson, Sweden).

POST OPERATIVE MOBILIZATION

All patients operated upon with an arthroplasty were informed about mobilisation techniques and were allowed to sit on a high chair immediately after surgery and to abandon the crutches at their on convenience. There were no restrictions after 6 weeks.

STATISTICAL METHOD

The statistical software used was SPSS for Windows. All scale variables and ordinal variables in independent groups were tested by the Mann-Whitney U-test. All nominal variables were tested by the Chi-square test or Fisher's exact test. All tests were two-sided. The results were considered significant at $p < 0.05$.

FRACTURE CLASSIFICATION

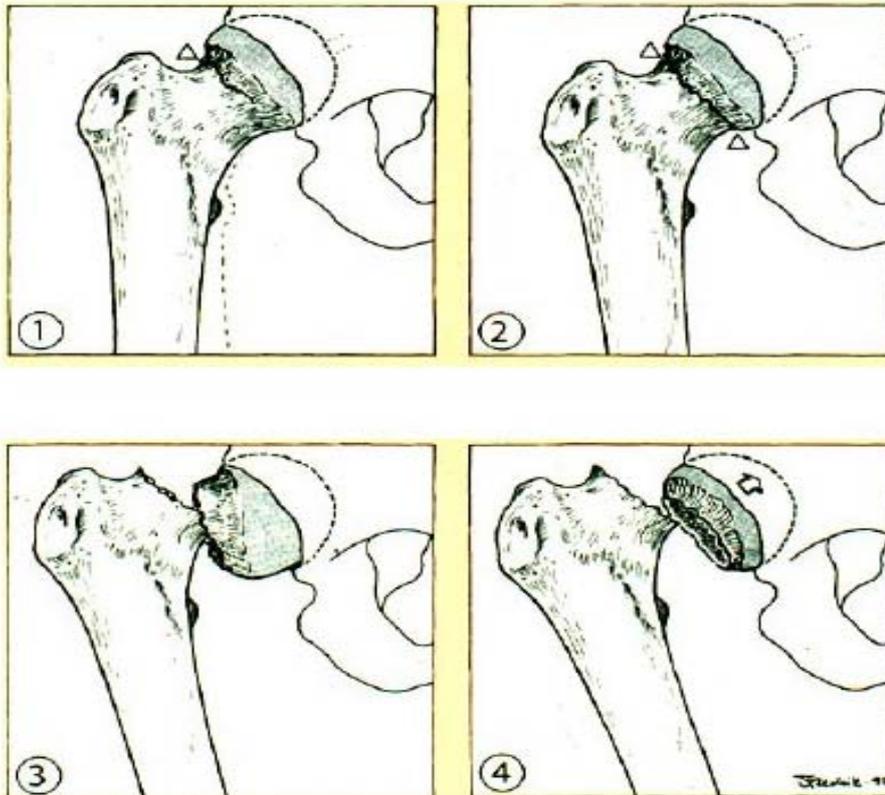
All patients included in my study had a displaced femoral neck fracture (Garden III and IV).²

The Garden classification is shown below.

The valgus-impacted Garden I fracture and the undisplaced Garden II fracture have the same good prognosis after internal fixation ⁴ and are referred to as undisplaced femoral neck fractures. The partially displaced Garden III fracture and the fully displaced Garden IV fracture have the same poor prognosis after internal fixation ^{4,12} and are referred to as displaced femoral neck fractures. It should also be emphasised that the Garden classification is based on the anterior-posterior (AP) view. Some dorsal angulation in the lateral view is not uncommon in Garden I fractures.

Garden's classification:

- **Undisplaced fractures of the femoral neck.**
 1. **Garden I, valgus impacted fracture.**
 2. **Garden II, undisplaced fracture.**
- **Displaced fractures of the femoral neck.**
 3. **Garden III, partially displaced fracture.**
 4. **4. Garden IV, fully displaced fracture.**



OBSERVATIONS AND RESULTS

POPULATION DISTRIBUTION

SEX DISTRIBUTION

MALE (% OF TOTAL)	FEMALE (% OF TOTAL)
9 (11%)	75 (89%)

The majority of the study population was female. This may be attributed to the age related osteoporosis found more commonly in women.

AGE DISTRIBUTION

70 – 80 YRS		80 – 90 YRS		TOTAL
MALE	FEMALE	MALE	FEMALE	
4	38	5	37	84

The mean age of the study population was 80 years.

SURGICAL OUTCOME

There were no differences in general complications and hip complications between the groups.

The indication for the secondary THR was non-union in 29 of 41 patients and avascular necrosis (AVN) in the remaining 12 patients.

PRIMARY THR	SECONDARY THR	
43	41	
	AVN	NON UNION
	12	29

TIME ELAPSED BETWEEN PRIMARY AND SECONDARY SURGERY

The mean time elapsed between IF and the secondary THR was 11 months. Among patients in whom the indication for the reoperation was non-union, the mean time elapsed was 8 months and, in patients with AVN, 16 months.

FUNCTIONAL OUTCOME

There were no significant differences in ADL between the groups at follow-up. Hip function was significantly better in the primary THR group and the HRQoL was assessed to be slightly higher in this group although not statistically significantly.

The patients with failed IF experienced a significant decrease in HRQoL during the first year compared with patients in the primary THR group.

Table showing Hip function according to the Charnley hip score and HRQoL (EQ-5D index score) at the 24-month follow-up after a primary THR (n=43) or secondary THR (n=41) after failed IF.

	PRIMARY THR	SECONDARY THR	P
	MEAN (SD)	MEAN (SD)	
HIP TOTAL SCORE	15 (2.3)	13 (2.6)	<0.001
HIP SCORE PAIN	5.6 (1.1)	4.7 (1.6)	0.005
HIP SCORE MOVEMENT	4.9 (0.7)	4.5 (0.9)	0.01
HIP SCORE WALKING	4.5 (1.5)	3.7 (1.3)	0.04
HRQoL SCORE	0.70 (0.28)	0.68 (0.20)	0.3

DISCUSSION

The finding of better hip function in the primary THR group is not surprising and is in agreement with a previous study on comparable groups.¹⁹ The patients with failed IF have to undergo a prolonged period of increased pain, impaired walking ability, and a decreased range of motion that may lead to immobilisation and subsequent muscular atrophy. Additionally, the previous surgical procedure and fracture healing complication may lead to local changes in the hip region such as scarring, shortening of the femoral neck, synovitis and, in some cases, secondary osteoarthritis due to AVN. These local changes are probably the explanation for the finding of increased perioperative bleeding and an increased need for postoperative blood transfusions in the secondary THR group.

In contrast to our study, McKinley et al.¹⁹ also found an increased frequency of superficial wound infections and postoperative dislocations in the secondary THR group. Moreover, they found an increased risk for prosthetic revision, with 10% of revisions in the primary THR group and more than 30% in the secondary THR group in a 10-year perspective. The main indication for revision arthroplasty was mechanical loosening. This is in contrast to the finding of the Swedish National Hip Arthroplasty Register where the prosthetic survival after a THR due to hip fracture, both primary and secondary, is comparable to that after a THR performed in patients with OA and RA.⁴³ Possible explanations for their finding of an increased risk for prosthetic loosening of the femoral component in the secondary THR group may be difficulties in positioning the stem optimally and the decreased possibility of pressurising the cement due to the remaining screw holes after IF. The patients with a failed IF may have to

wait a considerable time before their secondary THR. The mean duration was more than 8 months in patients with non-union and almost 16 months in patients with AVN. This reflects the time it takes to properly diagnose a fracture healing complication in patients with femoral neck fractures, but it may also partly reflect the waiting time for revision surgery.

The decrease in the present study was less pronounced probably because some of the patients had already had their secondary THR before the four-month follow-up. This particularly prolonged period of decreased quality of life is especially unfortunate in these elderly patients with a limited life expectancy. Therefore, it is important that we select a primary surgical procedure that minimises the number of reoperations and provides the best possible quality of life during the patients' remaining years.

The patients in the secondary THR group displayed inferior hip function compared to the patients in the primary THR group, but also compared to patients with an uneventfully healed fracture after IF. This corresponds with the findings in a case control study by Nilsson et al.,⁴⁴ in which the outcome was assessed with the Nottingham Health Profile (NHP). However, this is not an argument for performing IF as the primary procedure in this patient cohort considering the high failure rate after IF.^{4,12} The two-year failure rate in our RCT comparing primary THR with IF was 36% in the IF group, compared to 4% in the primary THR group.

The comparison between primary THR and secondary THR after failed internal fixation is difficult to make within an RCT although, to our knowledge, this has been partly done for the first time in this study. The matched case-control group of patients with secondary THR may be a selection of patients not perfectly comparable to the primary THR group. However, the two groups in the present

study were fully comparable regarding all inclusion criteria as assessed before the primary operation.

Furthermore, the indications for a revision arthroplasty are nearly always relative and are aimed at improving the patient's functioning and would most probably lead to a selection of healthier patients. All of the patients in the secondary THR group had to undergo a second orthopaedic and anaesthesiological assessment in which the indication for the salvage THR was balanced against surgical risks. Anyway, although it is not likely, if there was a negative selection to the secondary THR group, this might partly explain the differences between groups regarding walking ability but, in our opinion, it could not explain the significant difference regarding pain in favour of the primary THR group. Another weakness of this study is the limited number of patients, although the power seems appropriate to detect the differences in hip function between groups. In our opinion, the groups are comparable and we believe that the findings are amenable to generalisation.

RECOMMENDATIONS

PATIENT SELECTION CRITERIA

Based on the results of previous studies, and our this thesis, we suggest the following patient selection criteria for choosing between the different treatment modalities in patients with femoral neck fractures.

FRACTURE TYPE

The rate of fracture healing complications after IF in patients with undisplaced femoral neck fractures (Garden I and II) is in the range of 5-10% ⁴ in most studies with an adequate followup and good results regarding function and HRQoL can be expected.^{4,5}

Consequently IF should be performed in all patients with undisplaced femoral neck fractures, except in those with symptomatic osteoarthritis (OA) or rheumatoid arthritis (RA) affecting the fractured hip and in patients with pathological fractures. Patients with undisplaced fractures constitute approximately 25-30% of all femoral neck fractures.

Before selecting the treatment modality for patients with displaced (Garden III and IV) femoral neck fractures, constituting 70-75% of all patients with femoral neck fractures, we consider the age of the patient.

AGE OF THE PATIENT

The aim of assessing age is to estimate the patient's expected mean survival time. Patients with hip fractures have an increased mortality rate during the first

year after the fracture but after one year the mortality rate is comparable to that of the general population. The chosen surgical procedure in the patients should consider the patients age, mean expected survival, and medical co-morbidity.

The rate of fracture healing complications after IF in the younger age group is less well reported; however, due to the patients' longer life expectancy and consequently higher risk for revision surgery after an arthroplasty, IF is the preferred method. Most previous studies have used 65–70 years as the upper limit for IF,^{6-10, 57} but the optimal age limit is pending. Recently, 55 years has been suggested.¹¹

Patients with displaced fractures < 65 years of age constitute approximately 10% of all patients with displaced femoral neck fractures in Stockholm (Stockholm Hip Fracture Group, unpublished data). For selecting the treatment modality for patients aged ≥ 65 years with displaced fractures, Anaesthesiological assessment is an important criteria..

ANAESTHESIOLOGICAL ASSESSMENT

Ambulant patients aged ≥ 65 years with displaced fractures, considered by the attending anaesthesiologist not to be optimised for an arthroplasty procedure within 24 hours, are treated with IF. The cementing procedure during arthroplasty introduces an increased risk of perioperative complications especially in elderly patients with pre-existing cardiovascular conditions and a fracture diagnosis,⁵⁸ and therefore it is important that the patient's general medical condition can be optimised in the acute setting. Based on the results of a previous study²⁰ the uncemented Austin Moore Hemiarthroplasty is only

indicated as a salvage procedure after failed IF in extremely frail patients. The modern pressfit uncemented prosthetic stems may be a good alternative in the future but, so far, there is no convincing scientific evidence supporting their use in elderly osteoporotic hip fracture patients.

We have chosen a time limit of 24 hours for this preoperative assessment since a longer waiting time introduces an additional risk for complications due to the immobilisation. There is also a risk that the assessment, even after a longer period of time, will result in non-approval for arthroplasty and by that time the risk for fracture-healing complications after IF will have further increased. All patients with displaced fractures treated with primary IF are scheduled for a follow-up visit including a radiographic control at 4 months and, in case of a fracture-healing complication, they will be electively converted to an arthroplasty.

Ambulant patients aged ≥ 65 years with displaced fractures not optimised for arthroplasty <24 hours constitute 10-15% of all patients with displaced femoral neck fractures. Cognitive assessment is important before selecting the treatment modality for ambulant patients aged ≥ 65 years with displaced fractures optimised for arthroplasty within 24 hours.

FUNCTIONAL DEMANDS REFLECTED BY AGE

A primary THR has been shown to yield good results regarding the need for revision surgery and hip function^{6-10,14} for the active elderly patient with a

displaced femoral neck fracture. We therefore recommend THR for ambulant patients aged 65-79 years with displaced fractures who are optimised for an arthroplasty within 24 hours. These patients, constituting approximately 20% of all patients with displaced femoral neck fractures often have relatively high functional demands and their expected survival time is relatively long, indicating that they are the target population for THR.

For patients aged ≥ 80 years, ambulant and optimised for an arthroplasty within 24 hours³, we recommend bipolar HA. These patients, constituting approximately 40% of all patients with displaced femoral neck fractures have lower functional demands and their expected survival time is shorter. The reasonably good outcome of Hemiarthroplasty regarding hip function indicates that a bipolar HA with its more limited surgical impact and lower overall dislocation rate¹² constitutes sufficient treatment for these patients.

TO CONCLUDE:

There is increasing evidence that the treatment of elderly patients with displaced femoral neck fractures benefits from the individualised approach in which the selection of the surgical method is based on the individual patient's age, functional demands and risk profile. However, the results of recent studies are interpreted differently around the world and in certain institutions and healthcare systems there are obvious obstacles to fully adapting to this approach. Especially the use of THR in the primary treatment of patients with displaced femoral neck fractures seems to introduce logistic problems.

Further research is required to address controversies regarding treatment and to reach a consensus regarding the optimal lower age limit for primary THR.

CONCLUSION

The study showed that patients with a fracture healing complication after Internal Fixation will have a significant deterioration in the HRQoL during the treatment and that the secondary THR yielded an inferior outcome compared with a primary THR.

On the other hand, for the patient with a fracture healing complication, a secondary THR seems to be a safe salvage procedure with a good outcome, although not with a hip function outcome that is fully comparable to that after a primary THR.

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