Displaced femoral neck fractures: towards better practice

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Chapter 2

The current status of displaced femoral neck fracture treatment in The Netherlands

A questionnaire amongst general surgeons in 20 hospitals

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Abstract

Objective. Description of the treatment protocols for displaced femoral neck fractures (FNF) in 8 university hospitals (UH) and a sample of 12 non-university hospitals (NUH).

Design. Descriptive; questionnaire.

Method. General surgeons with an interest in traumatology received a questionnaire. They were requested to succinctly answer questions about local protocol for maximum time interval between hip trauma and operation, indications for internal fixation (IF) and arthroplasty, operative technique and postoperative degree of weight-bearing (WB) in patients over 60 years of age with a displaced FNF.

Results. IF and arthroplasty should be performed within 48 hours in 95% of all hospitals. A “biological” age limit between 65 and 80 years old was the most commonly quoted indication for IF in 70% of UH and NUH. In 83% of NUH dementia was an indication for arthroplasty, in contrast to 0% in UH. Poor bone quality, immobility, comminution and an inadequate reduction were incidentally quoted indications for arthroplasty. (Rheumatoid) arthritis and a pathologic fracture were contra-indications for IF in all hospitals. Operative technique of IF and arthroplasty was similar in UH and NUH. After IF, full WB was recommended in all UH and partial WB in 7 (58%) NUH. Following arthroplasty all protocols prescribed full WB.

Conclusion. The indications for IF or arthroplasty in UH and NUH showed a large variation, which reflects the lack of studies, that demonstrate clearly which patients may be treated optimally with either treatment modality. The operative technique of IF and arthroplasty showed less differences between the hospitals. Further study is warranted to identify which individual patients benefit from either IF or arthroplasty.
Introduction

In The Netherlands in 1999 15,286 patients (11,649 women) above 55 years of age were treated for a hip fracture. The average length of stay was 24 days, representing 3% of the total number of hospital admission days in the Netherlands. Around 12,000 of these patients were presented by ambulance to the Emergency Department (ED). The treatment cost of the latter group amounted to 212 million Euro's, 22% of the cost of all patients admitted via the ED. The lifetime risk of a hip fracture is 16%-18% for a Caucasian female and 5%-6% for a Caucasian male.

A femoral neck fracture is present in about half of this group. The fracture line in these cases runs proximal to the hip capsule insertion. These fractures can be divided into displaced fractures (72%) and undisplaced (impacted) fractures, which are essentially non-displaced (28%). Subclassifications (e.g. according to Garden) exist, but have no clinical consequences. The fracture does not heal without operative treatment and is an indication for surgery. The fracture may then be internally stabilised with screws or pins (internal fixation, IF) or the femoral head is extracted and replaced by an endoprosthesis (hemiarthroplasty, HA of total hip arthroplasty, THA). Above 60 years this fracture type has been named “the unsolved fracture”, as discussion still continues about the pros and cons of both treatment modalities.

Meta-analysis data of patients above 60 years of age show that arthroplasty decreases the chances of a revisional operation compared to IF; but at the cost of more infections, more blood loss, more operation time and possibly early mortality. Conclusions about pain and functional outcome in the longer term are not available.

The meta-analysis data are of limited use in daily practice, because all patients above 60 years are considered as one group. It is unclear which individual patients are better off with either treatment modalities. Studies with a high level of evidence concerning patients factors in relation to therapy and outcome are deficient. In The Netherlands the impression therefore existed that the treatment of displaced femoral neck fractures was subject to variation in different hospitals. The aim of this study was to describe how the displaced femoral neck fracture was treated according to local protocol in all university hospitals and a sample of non-university teaching hospitals.

Methods

At the end of 2001 a sample of all 8 university hospitals (UH) and 12 non-university teaching hospitals (NUH) in the region of each UH was taken. General Surgeons with an interest in Traumatology were invited to answer a questionnaire based on their
current local treatment protocol for displaced femoral neck fractures.

The questions concerned the pre-, peri-, en postoperative (< 3 days) treatment phase with IF or arthroplasty. Open questions were avoided. The preoperative questions concerned the use of ipsilateral limb traction, the maximum accepted time interval from hip trauma to surgery and the (contra-)indications for IF or arthroplasty. (Contra-) indications were listed based on those in the literature and could be answered with yes or no. In the perioperative phase the questionnaire inquired about patient positioning and the hip joint approach. For fracture reduction before IF the exact angles of accepted position of the femoral head on the fluoroscopic images were required. Postoperatively, the weight-bearing and physiotherapy consultation could be confirmed or refuted. Table 1 demonstrates the list of questions.

Table 1. List of questions

**PREOPERATIVELY:**
- Was ipsilateral limb traction performed?
- Maximum accepted time interval (hours) between hip trauma and operation?
- Indications for Internal Fixation according to list?
- Indications for arthroplasty according to list?

**PERIOPERATIVELY DURING INTERNAL FIXATION:**
- Patient position supine or lateral?
- Traction table or Leadbetter manoeuvre for fracture reduction?
- Which angle of the femoral head fracture line (or Garden Index) on the anterior-posterior fluoroscopic image is acceptable?
- Which angle of the axis through the central femoral head on the lateral fluoroscopic image is acceptable?
- Which implants are inserted according to protocol?
- On which day is weight bearing (full or partial) allowed postoperatively?
- Is physiotherapy consultation routine?

**PERIOPERATIVELY DURING ARTHROPLASTY:**
- Patient positioning supine or lateral?
- Which approach to the hip joint is taken? Anterolateral/lateral/posterior
- Excision of incision and closure of the joint capsule?
- Use of cement for endoprosthesis stem?
- Which type of endoprosthesis is inserted according to protocol?
- On which day is weight bearing (full or partial) allowed postoperatively?
- Is physiotherapy consultation routine?
The returned questionnaires were checked and missing answers were completed after consultation by telephone with the surgeon concerned. The answers from the UH and NUH were analysed separately to permit comparison. Statistical differences between non-normally distributed data were analyzed with the Mann-Whitney test. A p-value < 0.05 was considered significant.

Results
The questionnaire forms were returned by each hospital and where necessary missing answers were completed.

Preoperatively  Ipsilateral limb traction was performed in 4 out of 12 (33%) NUH. In UH traction was not indicated. According to local protocol IF was performed within 24 hours in 19 (95%) of the hospitals and arthroplasty in 17 (85%) hospitals within 48 hours, table 2. An age limit for performing IF was present in 16 (80%) of hospitals; a “biological” age below 70 years was most frequently quoted (range 65-80 years). “Biological” age as an indication for IF or arthroplasty was similarly present in both NUH and UH, as illustrated in table 3 and figure 1. In NUH dementia was a more frequent indication for arthroplasty. (Reumatoid) arthritis or a pathologic fracture were considered as absolute indications for arthroplasty. Incidentally, the following indications for arthroplasty were quoted: Parkinson's disease, cardiopulmonary morbidity, osteoporosis, comminution of the dorsal femoral neck, inadequate femoral head reduction intraoperatively, a fracture angle > 50° in relation

<table>
<thead>
<tr>
<th></th>
<th>Non university</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipsilateral limb traction</td>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>8</td>
</tr>
<tr>
<td>Acceptable time interval between trauma and IF</td>
<td>&lt; 8 hours</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>&lt; 24 hours</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>&lt; 36 hours</td>
<td>1</td>
</tr>
<tr>
<td>Acceptable time interval between trauma and arthroplasty</td>
<td>&lt; 24 hours</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>&lt; 48 hours</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>&lt; 72 hours</td>
<td>1</td>
</tr>
</tbody>
</table>

*p < 0.01
Table 3. Indications for internal fixation (IF) and arthroplasty (n=20).

<table>
<thead>
<tr>
<th>Indications</th>
<th>Non university</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF: (Biologic) age, see figure 1</td>
<td>11</td>
<td>5*</td>
</tr>
<tr>
<td>Always IF unless absolute contraindication‡ or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>‐ Inadequate reduction &gt; 75 years of age</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>‐ Poor bone quality/osteoporosis</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>‐ Dorsal commination</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Dementia</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Adequate reduction possible, no arthritis of the hip</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**Arthroplasty:**

<table>
<thead>
<tr>
<th>Indications</th>
<th>Non university</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Biologic) age, see figure 1</td>
<td>11</td>
<td>5*</td>
</tr>
<tr>
<td>Dementia</td>
<td>10</td>
<td>1**</td>
</tr>
<tr>
<td>Bed-chair patient</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>(Rheumatoid) arthritis</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Pathologic fracture</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

‡ Rheumatoid arthritis of the hip joint, pathologic fracture, * p = 0.33 , ** p < 0.01

![Figure 1](image)

Figure 1. Distribution of (biologic) age limits for internal fixation. Above the age limit arthroplasty was indicated.

to the horizontal plane, poor vascularisation of the femoral head on a technetium scan and a life expectancy below 15 years.

**Perioperatively – Fracture reduction and IF** IF was performed in the supine position with a traction table in all hospitals. The reduction technique according to Leadbetter was performed in 9 (45%) hospitals. Using this manoeuvre, free from the
traction table, the upper leg is manually flectec, endorotated and abducted to reduce the femoral neck fracture.\textsuperscript{11} In the other hospitals the fracture was reduced by traction and endorotation by using the devices attached to the traction table, table 4. Five criteria for fracture reduction are shown in table 4. Reduction of the femoral head in a maximum of 20° valgus (figure 2) on the Anterior-Posterior (AP) fluoroscopic image was prescribed in all UH. In 5 of 12 (42%) NUH anatomic reduction was allowed. On the lateral intraoperative image similar reduction criteria were found in the UH and NUH.

According to the protocols the implants for IF were: cannulated screws, compression hip screws (e.g. DHS, Synthes, Bettlach, Switzerland) and hip pins; figures 3, 4 and 5 illustrate the implants and correct positioning. The use of implants for IF was similar in UH and NUH, table 4.

In 13 (65%) hospitals patients were allowed full weight-bearing on the first day postoperatively. Partial weight-bearing after IF was advised 6 (50%) NUH. Physiotherapy was consulted in all hospitals as a routine measure.

**Perioperatively – Arthroplasty** Patient positioning, hip joint approach and in- or excision of the joint capsule was similar in UH and NUH. The lateral position was preferred in 13 (65%) hospitals. All endoprosthesis stems were cemented at the time
Figure 3a and 3b. Example of technically optimal Dynamic Hip Screw (DHS) placement. The DHS screw should be positioned below the line in the AP view, in the central or caudal part of the femoral head 5-10 mm from the subchondral bone. In the lateral view the screw should be positioned the central to dorsal part of the femoral head (circle).

Figure 4a and 4b. Technically optimal placement of cannulated screws according to the three-point fixation principle: First point: screw tip within the femoral head. Second point: the shaft of the lower dorsal screw rests on the cortex of the dorsal femoral neck; the shaft of the lower ventral screw rests on the calcar. Third point: the screw head within the lateral femur cortex.
Table 4. Perioperative measures, implants and postoperative management for Internal Fixation (n=20).

<table>
<thead>
<tr>
<th></th>
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<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reduction technique</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Closed with traction table or Leadbetter technique(^1)</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>- Open if closed reduction fails</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Criteria adequate reduction femoral head on the AP view</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- In valgus (Garden Index 160-180 degrees)</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>- Anatomic (Garden Index 160 degrees)</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td><strong>Criteria adequate reduction of femoral head on the lateral view</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Anatomic (0 degrees ante- or retroversion)</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>- 0-10 degrees ante- or retroversion</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>- Maximum 20 degrees retroversion</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Implants for internal fixation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- (Cannulated) screws</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>- Dynamic Hip Screw (DHS)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>- (Cannulated) screws or DHS or pins</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td><strong>Postoperative weight-bearing with physiotherapy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Full</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>- Partial</td>
<td>6</td>
<td>0(^*)</td>
</tr>
<tr>
<td>- None</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^*\) p < 0.01

*Figure 5a and 5b. Technically optimal placement of hip pins (without screwthread) with a hook for fixation within the femoral head. The pins are also placed according to the three-point fixation principal (see figure 4).*
Table 5. Perioperative measures for arthroplasty (n=20).

<table>
<thead>
<tr>
<th></th>
<th>Non university</th>
<th>University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient positioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Supine</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>- Lateral</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Surgical approach to the hip joint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Anterior or lateral</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>- Posterior</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Excision of the joint capsule</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Incision and closure of the joint capsule</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 6. Advantages and disadvantages of IF and arthroplasty during preoperative decision-making. Cost-effectiveness is based on recent studies. The percentages and relative risks (RR) are based on meta-analysis data.

Internal fixation

**Advantage**
- Retainment of natural hip
- Less surgical trauma and morbidity
- Early mortality possibly less (RR 0.8)

**Disadvantages**
- More risk of revision to arthroplasty (10-49%, RR 4.3)
- Less cost-effective after 2 years (total Euro 16.000)

Arthroplasty

**Advantages**
- Less risk of revision (0-24%, RR 0.2)
- More cost-effective after 2 years (total Euro 11.500)

**Disadvantages**
- More surgical trauma and morbidity
- More risk of infection around implant (3%, RR 1.8-3.8)
- Endoprosthesis dislocation requiring open or closed reduction (3-20%)
- Stem loosening (5%)
- Acetabular erosion in hemiarthroplasty (3%)

of the questionnaire. In 7 (35%) hospitals an antibiotic was added to the cement powder. Unipolar endoprosthesis heads were inserted in 15 (75%) hospitals and bipolar heads in 5 (25%) hospitals. All protocols prescribed full weight-bearing with optimal pain management with routine physiotherapy consultation on day 1, 2 or 3 postoperatively, table 5.
Discussion

This questionnaire, performed among general surgeons with an interest in traumatology, showed that the number of indications for the treatment of displaced femoral neck fractures was with IF or arthroplasty was variable in university (UH) and non university hospitals (NUH). Biologic age appeared to play a major role in the decision process, but the upper age limit for IF varied between 65 to 80 years. The applied technique in both types of operations was similar in UH and NUH.

The results of the questionnaire are limited by a number of factors. First, only general surgeons with an interest in traumatology received the questionnaire. It was clear to us that discussion about optimal treatment continues in this group. The board of the Dutch Association of Orthopaedic Trauma (NVOT) acknowledged the same discussion amongst their orthopaedic members. In the American orthopaedic literature the recent meta-analysis by Bhandari et al accentuates the most important points of discussion. Second, the sample of 1 of 2 regional NUH per UH may not be representative of all NUH. We believe that expansion of the number of NUH receiving the questionnaire would confirm the variation in indications.

Preoperatively skin and skeletal ipsilateral limb traction after hip fractures was not applied in the UH. A Cochrane analysis found no advantage of preoperative traction to prevent further fracture malalignment. IF was performed in 95% of hospitals within 24 hours and arthroplasty in 95% of hospitals within 48 hours. The maximum accepted time interval from hip trauma to operation was similar in UH and NUH. Acute cardiopulmonary pathology should be treated preoperatively to reduce mortality, but chronic pathology treatment does not reduce mortality, morbidity or postoperative function. A recent prospective cohort study among 1178 patients showed that medically stable patients should receive either IF or arthroplasty within 24 hours because of a significant association with less pain and shorter length of stay. After 48 hours the risk of complications rises, especially the development of pressure sores.

The protocols in 14 (70%) hospitals contained a “biologic” age limit between 65 and 80 years of age, under which IF and over which arthroplasty was performed. Determination of “biologic” age represents an estimation by the surgeon based on own experience and expertise (the lowest level of evidence). Mobility, accommodation status and medical history have been reported to play a role in determining “biologic” age, but were named in only 1 hospital. Previously a calendar age of 65-70 years was considered the upper limit for IF. An early prospective study showed that the
failure rate of IF rose to 50% at 85 years of age. More recently the upper limit of calendar age for IF is slowly rising to 80 years of age.

Dementia was considered to be an indication for arthroplasty in 10 (83%) NUH. In a randomised Dutch study among 60 demented patients IF in this group was preferred, because of less perioperative morbidity. It remains unclear which treat is optimal in this group of cognitively impaired patients.

The arbitrary application of the indications for IF or arthroplasty above, without proven criteria in the literature, is reflected in the questionnaire answers. In individual cases the decision –making presents a challenge. Table 6 sums up the (dis)advantages of both treatment modalities. To retain the natural hip joint patients may be inclined to accept a revision rate of 25%-36%, because failure can effectively be revised to arthroplasty.

Prior to IF anatomic to valgus reduction of the femoral head was required in the anterior-posterior view in all hospitals, see figure 2. Inadequate reduction, especially reduction in varus, is a proven risk factor for failure. Arthroscopy and open reduction is seldom necessary. In the lateral view more than 10 degrees of retroversion of the femoral head was allowed in 5 NUH en 4 UH. Expert opinion advises that the line through the centre of the femoral head should be in line with the axis of the femoral diaphysis. A maximum of 10 degrees of retroversion is acceptable, see figures 3b, 4b en 5b.

The application of the implants for IF in all 20 hospitals is supported by high-level evidence. A Cochrane analysis of 25 randomised studies showed similar outcome in patients treated with a compression hip screw or with cannulated screws and pins (figures 3, 4 en 5, relative risk (RR): 0.90). In steep fracture angles (> 50 degrees, Pauwels type 3) the fixed-angle compression hip screw has a theoretical advantage over non fixed-angle cannulated screws.

An anterior (14 hospitals) or posterior (6 hospitals) approach to the hip joint may be applied during arthroplasty, as dislocation rates are similar. Cementation of the prosthesis stem (all hospitals) is still the preferred treatment in anticipation of long term follow-up data about modern uncemented endoprostheses. Cementation leads to less pain and better mobility compared to non-cemented endoprostheses (RR: 0.51 en 0.60 respectively). After hemiarthroplasty dislocation rates of unipolar (15 hospitals) and the more expensive bipolar (5 hospitals) are similar (RR 1.12).

The effect of partial (7 NUH) versus full (all 8 UH) postoperative weight-bearing on clinical outcome after IF was analysed in one randomised study. At 1 year follow-up
similar clinical outcome was found for full weight-bearing after 2 weeks versus full-weight bearing after 12 weeks. Following IF and arthroplasty patients are probably best mobilised with full weight-bearing, which is in line with all UH protocols. In conclusion this questionnaire demonstrated that variable indications for deciding between IF and arthroplasty existed amongst the hospitals. This reflects the lack of high level evidence. The peri- and postoperative protocols for IF and arthroplasty were more similar and were in line with the available evidence. The questionnaire results and the available evidence warrant a large prospective randomised study containing enough patients to stratify for each possible subgroup of patients, which can only be achieved in an international setting. An optimal decision between IF and arthroplasty in individual patients may then be reached.

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References


