Surgical Management of Hip Fractures: An Evidence-based Review of the Literature. I: Femoral Neck Fractures

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Abstract

During the past 10 years, there has been a worldwide effort in all medical fields to base clinical health care decisions on available evidence as described by thorough reviews of the literature. Hip fractures pose a significant health care problem worldwide, with an annual incidence of approximately 1.7 million. Globally, the mean age of the population is increasing, and the number of hip fractures is expected to triple in the next 50 years. One-year mortality rates currently range from 14% to 36%, and care for these patients represents a major global economic burden. Surgical options for the management of femoral neck fractures are closely linked to individual patient factors and to the location and degree of fracture displacement. Nonsurgical management of intracapsular hip fractures is limited. Based on a critical, evidence-based review of the current literature, we have found minimal differences between implants used for internal fixation of displaced fractures. Cemented, unipolar hemiarthroplasty remains a good option with reasonable results. In the appropriate patient population, outcomes following total hip arthroplasty are favorable and appear to be superior to those of internal fixation.

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J Am Acad Orthop Surg 2008;16:596-607

Hip fractures are a common source of morbidity and mortality worldwide. In 1996, the United States Department of Health and Human Services reported approximately 340,000 hip fractures in the United States alone, with most fractures occurring in women older than age 65 years.[1] The number of people older than age 65 years is expected to increase from 37.1 million to 77.2 million by the year 2040, and the rate of hip fractures is expected to double concomitantly, with an estimated 6.3 million hip fractures predicted worldwide by 2050.[2,3] One-year mortality for hip fractures ranges from 14% to 36%, which is significant, considering the prevalence of such injuries.[4]

Management of hip fractures is based on individual patient factors, such as preinjury ambulatory status, age, cognitive function, and comorbidities, and on fracture factors, including fracture type and the degree of displacement. Treatment options include nonsurgical management,

percutaneous fixation, closed reduction and internal fixation, open reduction and internal fixation (ORIF), and arthroplasty (ie, hemiarthroplasty, total hip arthroplasty [THA]). Despite the variety of treatment options available, the question remains: What is the *best* treatment of intracapsular hip fractures in elderly patients? Our goal is to provide treatment recommendations in using an evidence-based approach.

A thorough, though not exhaustive, review of the hip fracture literature was undertaken to determine the most pertinent, highest-level studies available. The best studies for each parameter examined are succinctly reviewed herein. When level I or II evidence was not available, level III and IV studies were included. We then evaluated these studies to develop treatment recommendations. In addition to individual studies, we also used the Cochrane database and the Scottish Intercollegiate Guidelines Network (SIGN) database, both of which attempt to critically review literature in making treatment guidelines.

Femoral Neck Fracture

Femoral neck fractures are intracapsular and typically occur in a bimodal age distribution, with most occurring in the elderly population. The incidence of femoral neck fractures increases with age. The patient's medical history and preinjury status (ie, prior hip pain, ambulatory status, functional and mental capacity) provide valuable information that may influence the treatment course.

Nondisplaced Femoral Neck Fracture

Whether to manage nondisplaced femoral neck fractures nonsurgically or surgically is a topic of debate. Elderly patients with medical conditions that place them at high risk for anesthesia- and surgery-related complications can be treated nonsurgically. Nonambulatory patients and patients suffering from severe dementia who have minimal discomfort may also be treated nonsurgically. Surgical fixation for nondisplaced fractures allows early patient mobilization and ensures that a nondisplaced fracture does not subsequently displace.

Currently, there are no level I or II studies comparing nonsurgical with surgical management of nondisplaced femoral neck fractures.

We evaluated two level III studies and one level IV study of nondisplaced femoral neck fracture. Hansen[5] performed a nonrandomized study involving 23 patients, 16 of whom were treated nonsurgically and 7 of whom were treated surgically with sliding hip screws (SHSs). Nonunion occurred in 10 of 16 patients treated nonsurgically and in none of the surgically treated patients. Nine of 16 patients with a nonunion required revision surgery, whereas only 1 surgically treated patient required revision surgery.

An 86% union rate was reported in one study of 170 consecutive patients with impacted femoral neck fractures who were treated with early mobilization and weight bearing.[6] Patients older than age 70 years and in poor general health had the highest rate of secondary displacement. In a series of 1,400 patients, Parker et al[7] performed a cost-benefit analysis of various methods of treatment of hip fractures. The authors estimated a 30% 1-year mortality rate for patients whose nondisplaced subcapital fractures were treated nonsurgically and who had an uneventful union. For those patients with displaced subcapital fractures, the authors predicted a 90% 1-year mortality rate secondary to pneumonia, bedsores, and pulmonary emboli.

Conn and Parker[8] examined 375 patients with nondisplaced intracapsular fractures treated with internal fixation. The authors noted a nonunion rate of 6.4% and an osteonecrosis rate of 4.0%. Age, walking ability, degree of impaction evident on the anteroposterior radiograph, and angulation on the lateral radiograph were determined to be predictive of healing complications. In this study, the conversion rate to arthroplasty was 7.7%.

Based on the available evidence, a recommendation cannot be made regarding the treatment of nondisplaced femoral neck fractures (Table 1). The patient who is treated nonsurgically is not at risk of surgery-related complications, including wound infections or complications associated with anesthesia. However, the nonunion rate is increased, as are complications associated with prolonged recumbency. Although further randomized trials would provide more data, they may be difficult to conduct based on the modern standard of care and the limited indications for nonsurgical treatment.

Displaced Femoral Neck Fracture

The patient with a displaced femoral neck fracture is at significant risk for

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Table 1

Nonsurgical Versus Surgical Fixation of Nondisplaced Femoral Neck Fractures

Study	Level of Evidence	Cohort	Similar Outcomes	Conclusions
Hansen[5]	III	Nonsurgical vs surgical fixation (SHS)	—	Higher nonunion rate in the nonsurgical group, lower revision surgery rate in the surgical group
Raaymakers and Marti[6]	III	Nonsurgical: early mobilization and weight bearing	—	Patients aged >70 years and in poor general health had the highest rate of secondary instability
Parker et al[7]	III	Nonsurgical vs surgical fixation	—	One-year mortality was lower in the surgical group (30%) than in the nonsurgical group (90%)
Conn and Parker[8]	IV	Surgical fixation	—	Age, walking ability, impaction on AP radiograph, and angulation on lateral radiograph were predictive of healing complications

AP = anteroposterior, SHS = sliding hip screw

osteonecrosis and nonunion. Treatment options include closed reduction and internal fixation or ORIF with different constructs, hemiarthroplasty (unipolar and bipolar), and THA.

Internal Fixation

Many constructs have been used for internal fixation, including multiple screw fixation in a variety of configurations and SHSs. In our attempt to determine whether a particular implant provides superior fixation, we assessed outcomes such as rates of nonunion and osteonecrosis, need for hardware removal, periprosthetic fracture, and implant failure. The following data are all from level I studies.

A recent review of the Cochrane database revealed 28 randomized or quasirandomized trials of 5,547 patients with femoral neck fractures treated with 19 different pin and/or screw constructs in a variety of configurations.[9] None of the implants had significantly superior results for outcomes related to fracture healing, osteonecrosis, wound infection, pain scores, reoperation rate, use of walking aids, periprosthetic fracture, or mortality.

Seven studies compared outcomes between SHSs and various cancellous screws. Four studies noted shorter surgical times with cancellous screws (average, 11 minutes).[10-12] One study reported surgical times to be equivalent between the fixation methods.[13] In the SHS group, there was a tendency toward increased blood loss (average, 84 mL), and deep wound infection was more common. Although the overall reoperation rate was equivalent between the groups, failure of fixation was lower in the SHS group. There was not a significant difference in mortality between the groups.

Parker and Blundell[14] conducted a meta-analysis of 25 randomized controlled clinical trials (RCTs) involving 4,925 patients with intracapsular fractures who were treated with a variety of implants. The review and analysis were focused on complications associated with fracture healing. No investigated device proved to be superior to any other in terms of nonunion or fracture displacement. There was limited evidence supporting screw fixation over smooth pins; however, this advantage was negated with the use of a hook at the end of the pin. No advantage was seen in using a side plate for fixation, and no significant evidence was found concerning the number of screws necessary for fixation.

Based on the available evidence, there appear to be minimal differences between implants used for internal fixation of displaced femoral neck fractures (Table 2). These studies did not break down the data strictly based on age. Thus, it is not possible to recommend a particular implant for age-specific populations. The choice of implant should be based on surgeon familiarity and comfort level.

Internal Fixation Versus Hemiarthroplasty

Multiple studies have been done on the outcomes of internal fixation of femoral neck fractures versus arthroplasty (eg, hemiarthroplasty, THA). The risk of osteonecrosis, nonunion, and revision following internal fixation of displaced intracapsular fractures must be balanced against the potential complications following arthroplasty.

A review of the Cochrane database produced 13 randomized or quasirandomized controlled trials with a total of 2,091 patients treated with either internal fixation or hemiarthroplasty. One clear limita-

Table 2

Internal Fixation of Displaced Femoral Neck Fractures

Study	Level of Evidence	Cohort	Similar Outcomes	Conclusions
Parker and Stockton[9] (Cochrane review)	I	Multiple implants	Fracture healing, osteonecrosis, wound infection, pain scores, revisions, use of walking aids, periprosthetic fracture, mortality	No implant demonstrated significant superiority
Benterud et al[10]	I	Olmed screws vs SHS	Nonunion, osteonecrosis, revisions	Longer surgical time in the SHS group
Paus et al[12]	I	von Bahr screws vs SHS	Nonunion, osteonecrosis, mortality	More revisions for implant removal in the screw group; increased surgical time in the SHS group
Madsen et al[11]	I	Four cancellous screws vs SHS	Osteonecrosis, revision, deep wound infection	Higher union rate in the screw group at 2-year follow-up; increased length of surgery and blood loss in the SHS group
Kuokkanen et al[13]	I	Three cancellous screws vs SHS	Nonunion, osteonecrosis, revision, deep wound infection, length of surgery, mortality	No significant difference between implants
Parker and Blundell[14]	I	Multiple implants	Nonunion, osteonecrosis, fracture displacement	No device exhibited superiority over any other; screw fixation may be superior to pins

SHS = sliding hip screw

tion of this review is that different methods of internal fixation and different implants for arthroplasty were used. Outcomes assessed included surgical time, blood loss, wound infections, postoperative complications, and mortality.

Eight studies assessed the length of surgery, and all reported decreased surgical time for the patients treated with internal fixation (average, 22 minutes).[15] Additionally, the internal fixation group had a more favorable outcome in terms of blood loss, need for postoperative blood transfusions, and infection rates. No differences between the groups were found regarding mortality rates, pain, or mobility; however, there was a higher reoperation rate with internal fixation than with hemiarthroplasty (31% vs 8%; relative risk, 3.66).

In an RCT of 100 patients conducted by Rödén et al,[16] displaced femoral neck fractures were treated with either two von Bahr screws or a bipolar prosthesis. Inclusion criteria included age >70 years, no prior hip disease, ability to ambulate before injury, and no signs of senility. The duration of surgery was shorter and the blood loss less in the internal fixation group. This cohort did have a significant revision rate (34 of 53 patients). The prosthesis group was notable for a high dislocation rate (7 of 47 patients). No differences in patient mortality were noted at either 2- or 5-year follow-up.

Parker et al[17] reported on 455 patients randomized to either internal fixation or hemiarthroplasty and found no differences in outcomes for pain, mobility, or mortality at 3-year follow-up. However, the authors did note a lower rate of revision in the hemiarthroplasty group (5%) than in the group treated with internal fixation (40%). These results corroborated those of an earlier study by Parker and Pryor[18] of 208 patients treated with either internal fixation or hemiarthroplasty.

An RCT of internal fixation versus hemiarthroplasty in the year 2001 was terminated early because of a 44% revision rate at 1 year in the internal fixation group.[19] No revisions were needed in the hemiarthroplasty group. Rogmark et al[20] performed an RCT comparing internal fixation with hemiarthroplasty. At 2-year follow-up, patients who had undergone hemiarthroplasty had improved walking and stair-climbing ability, and decreased pain levels.

The available level II evidence seems to be consistent with the findings of level I studies, namely, that there is a higher revision rate for femoral neck fractures treated with internal fixation versus those managed with hemiarthroplasty. A meta-analysis by Lu-Yao et al[21] showed no difference in mortality in patients treated with internal fixation versus hemiarthroplasty, except for a non–statistically significant increase in the arthroplasty group in the first month (relative risk, 1.4). Nonunion developed in 33% of patients, and osteonecrosis in 16%, with reoperation rates

Table 3

ORIF Versus Hemiarthroplasty for the Management of Displaced Femoral Neck Fractures

Study	Level of Evidence	Cohort	Similar Outcomes	Conclusions
Masson et al[15] (Cochrane review)	I	ORIF vs hemiarthroplasty	Pain, mobility, mortality	Decreased surgical time, blood loss, and infection rate with ORIF, but a higher revision rate
Rödén et al[16]	I	von Bahr screws vs hemiarthroplasty	Mortality	Decreased surgical time and blood loss in the ORIF group, but a higher revision rate
Parker et al[17]	I	ORIF vs hemiarthroplasty	Pain, mobility, mortality	Decreased surgical time and blood loss in the ORIF group, but a higher revision rate and a greater rate of limb shortening
Parker and Pryor[18]	I	ORIF vs hemiarthroplasty	Functional outcome	Decreased surgical time and blood loss in the ORIF group and slightly decreased mortality, but a higher revision rate
Puolakka et al[19]	I	ORIF vs hemiarthroplasty	—	Higher revision rate and mortality in the ORIF group, so the study was terminated early; hemiarthroplasty was superior to ORIF
Rogmark et al[20]	I	ORIF vs hemiarthroplasty	—	Decreased length of surgery and hospital stay in the ORIF group but a higher complication rate; increased cost of ORIF over the first 2 years
Lu-Yao et al[21]	II	ORIF vs hemiarthroplasty	Postoperative complications, mobility, mortality	Increased pain relief and decreased revision with hemiarthroplasty

ORIF = open reduction and internal fixation

for these complications ranging from 20% to 36%. In the arthroplasty group, the rates of reoperation for any cause ranged from 6% to 18%.

The ideal treatment of displaced intracapsular fractures is not straightforward (Table 3). The current data indicate that internal fixation of femoral neck fractures is associated with a greater number of significant problems (eg, osteonecrosis, nonunion, revision) than is hemiarthroplasty. These risks outweigh the benefits of slightly shorter surgical times and marginally decreased blood loss. With similar mortality and pain scores, hemiarthroplasty appears to be the better option for displaced femoral neck fractures. However, other factors critical in the decision-making process, such as age, were not considered in most of these studies. Thus, we cannot make a definitive evidence-based judgment across all age groups and all circumstances as to the best treatment of displaced intracapsular hip fractures.

Cemented Versus Cementless Hemiarthroplasty

The first hip fracture endoprostheses were designed for cementless use, but cemented fixation has become the preferred technique with current femoral components. Numerous reports have documented improved outcomes with cemented implants.

Emery et al[22] performed an RCT of 53 hemiarthroplasties. Twenty-seven patients underwent cemented hemiarthroplasty, and 26 underwent cementless insertion. At a mean follow-up of 17 months, no statistically significant differences were noted between the groups with regard to postoperative complications, surgical time, estimated blood loss, or mortality. However, patients with cementless stems experienced a markedly higher level of hip pain and dependency on walking aids.

In a Cochrane database review, Parker and Gurusamy[23] evaluated five trials with a total of 482 patients. Although there was no difference in complication or mortality rates, there was a higher rate of failure to regain preoperative mobility in the cementless prosthesis group. Additionally, patients with cementless prostheses noted higher pain scores at follow-up. The conclusion of this review was that cementing the prosthesis led to reduced pain postoperatively and better mobility. However, in the trials, there was un-

derreporting of outcomes in a small cohort of patients, which was felt to limit any definitive conclusions.

In a systematic review of the literature (level II), Khan et al[24] found lower revision rates, less thigh pain, and better mobility in patients treated with cemented prostheses. There was no difference in general complications or mortality rates between the cemented and cementless groups.

Lo et al[25] reviewed 451 displaced fractures of the femoral neck with at least a 2-year follow-up and confirmed higher Harris hip scores and less thigh pain in the cemented group. The study reported longer average surgical times (20 minutes) and greater blood loss (160 mL) in the cemented group, but there was no significant difference in complication or mortality rates.

A review of the SIGN database concerning cemented versus cementless stems corroborated the findings of other studies in that cemented prostheses resulted in improved mobility postoperatively and decreased pain. In addition, the use of cemented implants did not cause a higher rate of postoperative complications, increased surgical time, greater blood loss, or mortality. The SIGN database cited a study in which the authors concluded that cementless stems are associated with higher levels of thigh pain and lower overall hip scores.[26] The recommendations by Dorr et al[26] suggested using a cemented prosthesis unless the patient exhibits cardiorespiratory compromise.

In a level III study, Lennox and McLauchlan[27] treated 207 patients with either cemented or cementless hemiarthroplasty for displaced subcapital fractures of the femoral neck. Follow-up was done at an average of 19 months postoperatively. Mortality was higher in the cemented group than in the cementless group at 48 hours and at 3 months (4% versus 0%). Excluding the perioperative period, the number of postoperative days until death was the same, suggesting that the use of cement may lead to higher mortality in the first 48 hours postoperatively. There were no differences in the overall complication rate, but patient satisfaction was higher in the cemented hemiarthroplasty group.

The findings of equivalent complication rates and higher patient satisfaction with cemented hemiarthroplasty were recently confirmed by Singh and Deshmukh.[28] However, in their review of 244 patients undergoing hemiarthroplasty, Foster et al[29] reported a higher rate of periprosthetic fracture in patients undergoing cementless versus cemented hemiarthroplasty (7% versus 0%). The authors noted that the patients in the cementless subgroup were significantly older; however, the ASA (American Society of Anesthesiologists) scores between the groups were comparable.

Based on a review of the current evidence, we recommend using cemented prostheses when performing hemiarthroplasty to manage displaced femoral neck fractures. There is reasonable support for cemented fixation, with the decreased incidence of postoperative pain and better mobility (Table 4).

Unipolar Versus Bipolar Hemiarthroplasty

Numerous studies have attempted to document possibly superior outcomes with the insertion of bipolar prostheses in patients with femoral neck fracture. Theoretically, because there is no prosthesis-prosthesis interface in a unipolar implant, the rate of acetabular wear should be reduced over time, and there should be a decreased incidence of pain and need for revision.

A review of the Cochrane database included seven randomized or quasirandomized trials involving 857 patients undergoing unipolar or bipolar hemiarthroplasty for femoral neck fracture.[23] The results indicated no significant difference in acetabular wear, functional outcomes, length of surgery, blood loss, wound infections, or mortality.

Raia et al[30] performed a prospective randomized trial comparing the efficacy of unipolar versus bipolar hemiarthroplasty in 115 patients older than age 65 years with displaced femoral neck fracture. Both types of prosthesis were cemented and implanted through a posterolateral approach. Patients were evaluated for quality of life and functional outcomes at 1 year postoperatively. The authors concluded that there was no difference in estimated blood loss, length of hospital stay, mortality rate, number of dislocations, postoperative complications, or ambulatory status. Thus, the bipolar endoprosthesis provided no advantage in the treatment of displaced femoral neck fractures.

Calder et al[31] performed a randomized prospective study in 250 patients aged 80 years and older to determine the rate of complications, patient satisfaction, Harris hip scores, degree of return to preinjury state, and mortality. The only significant difference between the two groups involved return to preinjury status, which was significantly greater ($P = 0.04$) following insertion of the unipolar prosthesis.

The SIGN database documents level II evidence comparing unipolar with bipolar prostheses. One study included a fluoroscopic evaluation of the bipolar prostheses.[32] The radiologic data suggested that the majority of motion occurred at the outer articulation (acetabulum-prosthesis interface). There was little, if any, motion at the bipolar interface, which essentially served to convert the bipolar prosthesis to a unipolar device. The bipolar design was created to reduce acetabular wear as well as to minimize pain and maximize mobility. The review concluded that these outcomes are related to patient activity level and duration of follow-up. The SIGN recommendation stated that bipolar hemiarthroplasty

Table 4

Cemented Versus Cementless Hemiarthroplasty for the Management of Displaced Femoral Neck Fractures

Study	Level of Evidence	Cohort	Similar Outcomes	Conclusions
Emery et al[22]	I	Cemented vs cementless hemiarthroplasty	Length of surgery, blood loss, postoperative complications, mortality	Increased hip pain and dependency on walking aids in the cementless group
Parker and Gurusamy[23] (Cochrane review)	I	Cemented vs cementless hemiarthroplasty	Length of surgery, blood loss, implant-related complications, postoperative complications, mortality	Increased rate of failure to regain mobility and more postoperative pain ≥1 year in the cementless group
Khan et al[24]	II	Cemented vs cementless hemiarthroplasty	General complication rate, mortality	Increased surgical time and blood loss in the cemented group, but decreased revision rate and pain, and increased mobility
Lo et al[25]	II	Cemented vs cementless hemiarthroplasty	Mortality	Decreased thigh pain and increased Harris hip score in the cemented group, but increased surgical time and blood loss
Dorr et al[26]	II	Cemented vs cementless hemiarthroplasty	Mortality	Pain scores and mobility better in the cemented group, walking aids more common in the cementless group
Lennox and McLauchlan[27]	III	Cemented vs cementless hemiarthroplasty	Long-term mortality, complication rate	Higher perioperative mortality in the cemented group, but greater patient satisfaction
Singh and Deshmukh[28]	III	Cemented vs cementless hemiarthroplasty	Complication rate, hospital stay, mortality	Greater patient satisfaction in the cemented group
Foster et al[29]	III	Cemented vs cementless hemiarthroplasty	—	Increased risk of periprosthetic fracture in cementless group

should not be performed in preference to unipolar hemiarthroplasty because there is limited evidence of clinical benefit with a bipolar prosthesis.

Eiskjaer and Ostgård[33] reported on a total of 679 cases, which included 202 unipolar Austin Moore prostheses, 209 trunion-bearing Christiansen devices, and 268 Hastings bipolar hemiarthroplasty devices. The cumulative prosthesis survival was 90% at 5-year follow-up and 85% at 10-year follow-up. In contrast to other studies, significantly fewer failures were noted in the group undergoing cemented bipolar hemiarthroplasty.

Yamagata et al[34] reported on 1,001 hemiarthroplasties (682 unipolar, 319 bipolar). The survivorship results of this level III study demonstrated a 13.7% revision rate at 8-year follow-up for bipolar components, compared with 22.9% for unipolar prostheses. In addition, patients undergoing bipolar hemiarthroplasty exhibited higher average Harris hip scores and lower acetabular erosion rates compared with those managed with the unipolar devices.

In a level IV study, Haidukewych et al[35] reviewed the results and survivorship of 212 cemented bipolar hemiarthroplasties in 205 patients (average age, 79 years). The authors reported 10-year survivorship free of revision for any reason of 93.6%. This rate increased to 95.9% when factors other than mechanical failure (ie, aseptic loosening, acetabular wear) were excluded. The authors concluded that cemented bipolar hemiarthroplasty was associated with excellent component survivorship in elderly patients. They documented a low complication rate (11%) and satisfactory pain relief (96%).

Given the variable conclusions from numerous level I through IV studies concerning hemiarthroplasty, absolute recommendations cannot be made concerning the type of implant to be used (Table 5). There is limited evidence to support the use of a bipolar prosthesis over unipolar designs. Although there is a theoretical design advantage with bipolar implants, these advantages have yet to be confirmed in clinical studies. Additional large-scale RCTs are needed to definitively answer this question.

Surgical Approach

Surgical approach reportedly affects the incidence of dislocations

Table 5

Unipolar Versus Bipolar Hemiarthroplasty for the Management of Displaced Femoral Neck Fracture

Study	Level of Evidence	Cohort	Similar Outcomes	Conclusions
Parker and Gurusamy[23] (Cochrane review)	I	Unipolar vs bipolar hemiarthroplasty	Dislocation rate, acetabular erosion, deep wound sepsis, revision rate, DVT rate, mortality	Inadequate evidence to support or refute the use of a bipolar prosthesis
Raia et al[30]	I	Unipolar vs bipolar hemiarthroplasty	Blood loss, hospital stay, dislocation rate, ambulatory status, quality of life scores, postoperative complications, mortality	Bipolar devices provide no advantage in terms of quality of life or functional outcomes
Calder et al[31]	I	Unipolar vs bipolar hemiarthroplasty	Complication rate, Harris hip score, pain scores, mortality	Return to preinjury status significantly greater in the unipolar group. The authors could not justify the use of a bipolar device in patients aged >80 years.
Eiskjaer and Ostgård[33]	II	Unipolar vs bipolar hemiarthroplasty	—	Bipolar prosthesis and age >75 years associated with fewer failures
Yamagata et al[34]	III	Unipolar vs bipolar hemiarthroplasty	—	Higher revision rate and increased acetabular erosion in the unipolar group
Haidukewych et al[35]	IV	Bipolar hemiarthroplasty	—	93.6% revision-free survivorship at 10 years for the bipolar prosthesis, with low complication rate and good pain relief

DVT = deep vein thrombosis

and infections, duration of surgery, and blood loss. Most frequently, an anterolateral or a posterior approach is performed. The question is whether there is an ideal surgical approach that minimizes complications and causes the least possible morbidity.

No level I study has specifically evaluated the surgical approach. A review of the Cochrane database identified only one RCT of 114 patients comparing surgical approaches for hemiarthroplasty (level II). Sikorski and Barrington[36] followed for 2 years 57 patients who had undergone either an anterolateral or a posterior approach for displaced subcapital femoral fracture. A cemented Thompson prosthesis was used for all patients. The rates of dislocation, prosthesis loosening, acetabular protrusion, wound infection, and revision were similar between the groups. Of note, medical complications, including pneumonia, congestive heart failure, and urinary tract infections, were higher in the posterior approach group, as was postoperative mortality (25% vs 42% at 2-year follow-up). The postoperative protocol followed at that time (ie, prolonged bed rest to prevent posterior dislocation) may have contributed to these findings. Additionally, selection bias and poor, somewhat inconsistent reporting of results may have compromised the integrity of the study.

Keene and Parker[37] conducted a prospective study of 531 patients who underwent hemiarthroplasty with either an anterior or a posterior approach. The anterolateral approach was associated with increased surgical time (8 minutes longer), blood loss (54 mL), and superficial infection (6% versus 2.6%). However, the report also indicated that the posterior approach was associated with a higher dislocation rate (4.3% versus 1.7%) and more thromboembolic complications (9.2% versus 1.3%). There was no difference in hospital stay or mortality, and the authors suggested that surgeon comfort with the approach should dictate the exposure used.

In their level IV case series of 1,812 bipolar hemiarthroplasties, Sierra et al[38] found no significant differences in their comparison of dislocation rates between anterolateral, posterolateral, and transtrochanteric approaches. The authors noted a total of only 32 dislocations, half of which occurred during the first 6 months postoperatively.

In 2004, Varley and Parker[39] performed a systematic literature review of dislocations and surgical ap-

Table 6

Surgical Approach for the Management of Displaced Femoral Neck Fracture

Study	Level of Evidence	Cohort	Similar Outcomes	Conclusions
Sikorski and Barrington[36]	II	Anterolateral vs posterior approach	Prosthesis loosening, acetabular protrusion, wound infection, revision	Higher rate of medical complications and mortality with the posterior approach
Keene and Parker[37]	II	Anterolateral vs posterior approach	—	Increased surgical time, blood loss, and superficial infection with the anterolateral approach; higher dislocation rate and thromboembolic complications with the posterior approach
Sierra et al[38]	IV	Anterolateral, posterolateral, or transtrochanteric approach	—	No association of dislocation with any particular surgical approach
Varley and Parker[39]	IV	Anterolateral vs posterior approach	—	Higher dislocation rate with the posterior approach and a cemented prosthesis; no difference between unipolar and bipolar devices

proach during a 40-year period. They found that the rate of dislocation with a posterior approach was 5.1%, compared with 2.4% for an anterior approach.

There is a lack of strong evidence to advocate one particular surgical approach for hemiarthroplasty (Table 6). In the absence of data from well-designed RCTs, the choice of surgical approach will be based primarily on the surgeon's clinical assessment of each patient's needs and the surgeon's surgical experience.

Internal Fixation Versus Total Hip Arthroplasty

Indications for THA following a displaced femoral neck fracture have included the presence of preexisting osteoarthritis, rheumatoid arthritis, and degenerative joint disease secondary to Paget's disease. However, more recently there has been increased enthusiasm for primary THA for managing displaced femoral neck fractures.

Tidermark et al[40] conducted a prospective RCT of 102 patients (mean age, 80 years) with displaced femoral neck fractures treated with either internal fixation or THA. Outcomes measures included hip function, quality of life, complications, and revision surgery. At 2-year follow-up, the complication rate (36% versus 4%, $P < 0.001$) and revision rate (42% versus 4%, $P < 0.001$) were significantly higher in the internal fixation group than in patients treated with THA. Hip function in terms of quality of life ($P < 0.05$), comfort ($P < 0.005$), motion ($P < 0.05$), and walking ability ($P < 0.05$) were all significantly better in this group of independent, cognitively intact patients treated with THA. At 4-year follow-up, the same investigators reported that the incidence of complications and revisions in the internal fixation group had increased but that no additional complications were reported, and no revisions were required in the arthroplasty group.[41] Similar results were seen in a larger RCT conducted by Rogmark et al,[42] who noted improved pain scores ($P < 0.05$) and walking ability ($P < 0.05$) in the THA group. The mortality rate at 2-year follow-up was 21% for both groups, with a higher mortality rate among men (33% versus 18%). Johansson et al[43] also found an increased rate of complications at 1-year follow-up in patients with intact cognition who underwent internal fixation. Patients with compromised mental status had a higher rate of complications and a higher mortality rate at 2 years following ORIF (57.7% versus 12.7%).

Ravikumar and Marsh[44] performed an RCT of 290 patients older than age 65 years, comparing internal fixation, hemiarthroplasty, and THA. At 13-year follow-up, revision rates were the lowest (6.75%) and Harris hip scores were the highest (80) in the patients who had undergone THA. The internal fixation and hemiarthroplasty groups had revision rates of 33% and 24%, respectively. Skinner et al[45] also randomized 278 patients to ORIF, hemiarthroplasty, or THA for displaced femoral neck fractures. They showed equivalent mortality at 1 year postoperatively (25%). The internal fixation group exhibited the highest revision rate (25%). Pain relief and mobility were best in the THA group.

Bhandari et al[46] conducted a meta-analysis of all RCTs reported over a 33-year period, comparing internal fixation and arthroplasty (ie, hemiarthroplasty, bipolar arthroplasty, THA). Cumulative data showed a decreased rate of revision surgery in the

Table 7

ORIF Versus THA for the Management of Displaced Femoral Neck Fracture

Study	Level	Cohort	Similar Outcomes	Conclusions
Tidermark et al[40]	I	ORIF vs THA	—	Hip complications, revision rate, and mortality were higher in the ORIF group; hip function scores and decline in QOL were better in the THA group
Blomfeldt et al[41]	I	ORIF vs THA	Mortality	Increased hip complications and revision rate in the ORIF group
Rogmark et al[42]	I	ORIF vs THA	Mortality	Higher failure rate and decreased hip function in the ORIF group
Johansson et al[43]	I	ORIF vs THA	Mortality	Fewer fracture-related complications and higher Harris hip scores in the THA group, but a higher general complication rate reported
Ravikumar and Marsh[44]	I	ORIF, hemiarthroplasty, or THA	Mortality	Highest Harris hip scores and lowest revision rates in the THA group; poor outcomes related to hip function in the ORIF and hemiarthroplasty groups
Skinner et al[45]	I	ORIF, hemiarthroplasty, or THA	General complications, mortality	Least pain and most mobility at 1-year follow-up in the THA group; revision rate highest in the ORIF group; the hemiarthroplasty group had the worst hip scores
Bhandari et al[46]	I	ORIF vs arthroplasty	Pain relief, overall function, 1-year mortality	Increased surgical time and greater blood loss, as well as early mortality rates, but less revision surgery and better pain relief in the THA group
Keating et al[47]	II	ORIF, hemiarthroplasty, or THA	Mortality	Highest revision rates and lowest hip and QOL scores in the ORIF group; highest functional outcome scores at 2-year follow-up in the THA group
Abboud et al[48]	III	THA (Fx) vs THA (OA)	Length of surgery, blood loss, postoperative complications, Harris hip score, mortality	Comparable outcomes

Fx = fracture, OA = osteoarthritis, ORIF = open reduction and internal fixation, QOL = quality of life, THA = total hip arthroplasty

arthroplasty group and an increased risk of infection. The relative risk of mortality in the arthroplasty group was higher during the first 4 months postoperatively but was no longer evident at 1-year follow-up.

The most recent multicenter RCT comparing internal fixation, hemiarthroplasty, and THA in cognitively intact patients was performed by Keating et al[47] (level II). At 2-year follow-up, revision surgery was required in 39% of the internal fixation group, 5% of the hemiarthroplasty group, and 9% of the THA group. Hip scores and quality of life measurements were significantly greater in the THA group than in the other two groups. Economic analysis revealed that internal fixation was least costly to perform acutely but was most costly after including the cost of additional treatment of complications.

As the popularity of treating femoral neck fractures with THA has increased, outcomes have been compared with those of patients undergoing THA for degenerative conditions. A retrospective study of 60 patients by Abboud et al[48] showed no difference in outcomes for patients undergoing THA for femoral neck fractures versus those undergoing THA for osteoarthritis. Harris hip scores, perioperative morbidity, and mortality were equivalent for both groups. This is in contrast to earlier studies that showed increased rates of dislocation in patients undergoing primary THA for femoral neck fractures.

Current level I and II evidence indicates that as the index procedure for a femoral neck fracture, THA leads to better outcomes than does internal fixation, as measured by hip function scores and a decreased rate of revision surgery (Table 7). This option should be strongly considered for the healthy, cognitively intact patient. Ultimately, more RCTs are needed to further clarify the risks

and benefits of each procedure for clearly defined patient groups.

Summary

There is no clear evidence indicating that any particular implant is superior for internal fixation of displaced femoral neck fractures. Although multiple screw fixation is most common, and the use of SHSs may be associated with slightly longer operating times and increased blood loss, implant selection will continue to be determined based on surgeon preference and experience.

Implant type, cementing techniques, and surgical approach should all be considered when performing hemiarthroplasty. There is some evidence that bipolar implants are superior to unipolar prostheses; studies do not indicate that outcomes justify their increased cost. Cementing of components seems to lead to less postoperative pain. Although data indicate that an anterior approach results in a lower dislocation rate with potentially longer operating times and an increased infection rate, there are no overwhelming data supporting one approach over another. Surgeon experience and preference are important factors. Managing displaced femoral neck fractures with THA in the cognitively intact elderly patient is well-supported in the literature, particularly in comparison with internal fixation. Further study is needed to determine which patients can be best treated with arthroplasty.

"Surgical Management of Hip Fractures: An Evidence-based Review of the Literature. II: Intertrochanteric Fractures" will be published in the November 2008 issue of the *Journal of the American Academy of Orthopaedic Surgeons*.

References

Evidence-based Medicine: There are several level I/II prospective studies (references 9-26, 30-33, 36, 37, and 40-47). Level III/IV case-control and cohort studies include references 5-8, 27-29, 34, 35, 38, 39, and 48.

Citation numbers printed in **bold type** indicate references published within the past 5 years.

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