MANAGEMENT OF HIP FRACTURES IN THE ELDERLY

SUMMARY

This Guideline has been endorsed by the following organizations:
Disclaimer

This Clinical Practice Guideline was developed by an AAOS physician volunteer Work Group based on a systematic review of the current scientific and clinical information and accepted approaches to treatment and/or diagnosis. This Clinical Practice Guideline is not intended to be a fixed protocol, as some patients may require more or less treatment or different means of diagnosis. Clinical patients may not necessarily be the same as those found in a clinical trial. Patient care and treatment should always be based on a clinician’s independent medical judgment, given the individual patient’s clinical circumstances.

OVERVIEW

This clinical practice guideline is based on a systematic review of published studies with regard to the management of hip fractures in patients over the age of 65. In addition to providing practice recommendations, this guideline also highlights limitations in the literature and areas that require future research.

This guideline is intended to be used by all qualified and appropriately trained physicians and surgeons involved in the management of hip fractures in the elderly. It is also intended to serve as an information resource for decision makers and developers of practice guidelines and recommendations.

INTENDED USERS

This guideline is intended to be used by orthopaedic surgeons and physicians managing elderly patients with hip fractures. Typically, orthopaedic surgeons will have completed medical training, a qualified residency in orthopaedic surgery, and some may have completed additional sub-specialty training. Insurance payers, governmental bodies, and health-policy decision-makers may also find this guideline useful as an evolving standard of evidence regarding management of hip fractures in the elderly. Adult primary care physicians, geriatrcians, hospital based adult medicine specialists, physical therapists, occupational therapists, nurse practitioners, physician assistants, emergency physicians, and other healthcare professionals who routinely see this type of patient in various practice settings may also benefit from this guideline.

Hip fracture management is based on the assumption that decisions are predicated on the patient and/or the patient’s qualified heath care advocate having physician communication with discussion of available treatments and procedures applicable to the individual patient. Once the patient and or their advocate have been informed of available therapies and have discussed these options with his/her physician, an informed decision can be made. Clinician input based on experience with conservative management and the clinician’s surgical experience and skills increases the probability of identifying patients who will benefit from specific treatment options.
SUMMARY OF RECOMMENDATIONS

The following is a summary of the recommendations of the AAOS Clinical Practice Guideline on the Management of Hip Fractures in the Elderly. This summary contains rationales that explain how and why these recommendations were developed; however, it does not contain the evidence reports supporting these recommendations. All readers of this summary are strongly urged to consult the full guideline and evidence report for this information. We are confident that those who read the full guideline and evidence report will see that the recommendations were developed using systematic evidence-based processes designed to combat bias, enhance transparency, and promote reproducibility.

This summary of recommendations is not intended to stand alone. Treatment decisions should be made in light of all circumstances presented by the patient. Treatments and procedures applicable to the individual patient rely on mutual communication between patient, physician, and other healthcare practitioners.

ADVANCED IMAGING

Moderate evidence supports MRI as the advanced imaging of choice for diagnosis of presumed hip fracture not apparent on initial radiographs.

**Strength of Recommendation: Moderate**

**RATIONALE**

Five low strength studies evaluated the use of MRI to assess for hip fractures in patients with a clinical history consistent with fracture but negative plain films. The included studies demonstrated the ability of MRI to identify fractures, especially in older patients (Chana et al 1). The studies also noted that MRI was able to demonstrate causes of hip pain other than fracture (Harrmati et al 2, Kirby et al 3, Lim et al 4, and Pandey et al 5). Only one low strength study (Lee et al 6) was available that evaluated the sensitivity of bone scan in detecting occult hip fractures. Rizzo et al. 7 noted equivalent accuracy when comparing MRI to bone scan in this setting; however, MRI was found to provide a diagnosis earlier (Rizzo et al. 7) than bone scan, with better spatial resolution. In this study, MRI was obtained within 24 hours of admission and bone scan within 72 hours. For situations in which MRI is not immediately available, bone scan can be considered (Rizzo et al). 7 In addressing issues of cost and patient discomfort, three studies showed that a “limited” MRI of the hip could identify occult hip fractures (Lim et al 4, Iwata et al 8, Quinn et al 9); these limited scans were obtained with lower cost and shorter duration that standard MRIs.

Limited, small studies have examined the use of CT scan in the diagnosis of occult hip fractures. Due to the quality of existing literature, as well as potential harm with radiation exposure related to use of CT in this setting, this modality was not recommended for evaluation of occult hip fracture.
PREOPERATIVE REGIONAL ANALGESIA

Strong evidence supports regional analgesia to improve preoperative pain control in patients with hip fracture.

Strength of Recommendation: Strong

RATIONALE

Six high strength studies (Fletcher et al\textsuperscript{10}, Foss et al\textsuperscript{11}, Haddad et al\textsuperscript{12}, Monzon et al\textsuperscript{13}, Mouzopoulos et al\textsuperscript{14}, and Yun et al\textsuperscript{15}) and one moderate strength study (Matot, 2003\textsuperscript{16}) showed beneficial outcomes. Six studies inclusive of 593 patients used a prospective randomized clinical trial design to assess the effect of regional analgesia in reducing preoperative pain after hip fracture upon presentation to the emergency department (Fletcher et al\textsuperscript{10}, Foss et al\textsuperscript{11}, Haddad et al\textsuperscript{12}, Monzon et al\textsuperscript{13}, Mouzopoulos et al, and Yun et al\textsuperscript{15}). These studies all used a technique of administration of a local anesthetic that results in temporary loss of nerve function in the fascia iliaca or femoral compartment of the injured hip. In each study the patients who received this agent reported significant reduction in reported preoperative pain on a visual analog scale. One of these studies reported improved reported pain at time of administering spinal anesthesia.

The administration of regional analgesia in these six studies was performed by a different group of providers in each study including: emergency physicians, anesthesiologists, and orthopaedic surgeons (Fletcher et al\textsuperscript{10}, Foss et al\textsuperscript{11}, Haddad et al\textsuperscript{12}, Monzon et al\textsuperscript{13}, Mouzopoulos et al\textsuperscript{14}, and Yun et al\textsuperscript{15}). All the providers who were administering the analgesia were trained in performance of the specific technique before the study began. One study found the technique for this type of regional analgesia administration can be successfully taught to medical providers who were inexperienced in these skills (Fletcher et al\textsuperscript{10}).

In all of these trials pain recorded with a visual analog score is a reported outcome (Fletcher et al\textsuperscript{10}, Foss et al\textsuperscript{11}, Haddad et al\textsuperscript{12}, Matot, et al\textsuperscript{16}, Monzon et al\textsuperscript{13}, Mouzopoulos et al\textsuperscript{14}, and Yun et al\textsuperscript{15}). Reported outcomes in five of the trials were limited to the preoperative episode of care for the studies patients (Fletcher et al\textsuperscript{10}, Foss et al\textsuperscript{11}, Haddad et al\textsuperscript{12}, Monzon et al\textsuperscript{13}, and Yun et al\textsuperscript{15}).

Two trials reported effects beyond this initial preoperative period. One trial reported a reduction in the incidence of postoperative delirium in addition to a reduction in preoperative pain levels in the population who received regional analgesia. Incidence of delirium with the regional analgesia group was 11\% (11/102) and 24\% (25/105) in the control group [relative risk 0.45, 95\% CI 0.23-0.87] (Mouzopoulos et al\textsuperscript{14}). The seventh study reported the use of epidural anesthesia administered preoperatively in hip fracture patients with known cardiac disease or who were at high risk for cardiac disease was associated with reduction of preoperative myocardial ischemia events; Adverse preoperative cardiac events occurred in 7 of 34 patients in the control group and 0 of 34
patients in the treatment group \( p = 0.01 \) (Matot et al. 16).

No complications were reported in these studies using a technique of administration of a numbing agent that results in temporary loss of nerve function in the femoral compartment of the injured hip. However, the consideration of standard risks and benefits of these techniques should be considered when implementing this recommendation.

**PREOPERATIVE TRACTION**

Moderate evidence does not support routine use of preoperative traction for patients with a hip fracture.

*Strength of Recommendation: Moderate ★★★☆☆*

**RATIONALE**

Seven moderate strength studies (Anderson et al. 17, Finsen et al. 18, Needoff et al. 19, Resch et al. 20, Rosen et al. 21, Saygi et al. 22, Yip et al. 23) compared skin traction to no traction. There was no difference noted between the two groups with regard to decreased pain or decreased doses of analgesia administered. A meta-analysis of the data showed that preoperative traction offered no benefit to hip fracture patients.

One high strength study (Resch et al. 24) showed no difference in pain alleviation and number of analgesics administered when comparing skeletal traction to skin traction in hip fracture patients. However, half of the patients in the skeletal traction group found the application of skeletal traction to be painful.

**SURGICAL TIMING**

Moderate evidence supports that hip fracture surgery within 48 hours of admission is associated with better outcomes.

*Strength of Recommendation: Moderate ★★★☆☆*

**RATIONALE**

Nine moderate strength studies evaluated patient outcomes in relation to timing of hip fracture surgery (Elliot et al. 25, Fox et al. 26, McGuire et al. 27, Moran et al. 28, Novack et al. 29, Orosz et al. 30, Parker et al. 31, Radcliff et al. 32, Siegmeth et al. 33). In many of these studies the presence of increased comorbidities represented a confounding effect, and therefore delays for medical reasons were often excluded.

The majority of studies favored improved outcomes in regards to mortality, pain, complications, or length of stay (Elliot et al. 25, McGuire et al. 27, Novack et al. 29, Orosz et al. 30, Parker et al. 31, and Siegmeth et al. 33). Although several studies showed a benefit of surgery within 48 hours, one study showed no harm with a delay up to four days for patients fit for surgery who were not delayed for medical reasons (Moran et al. 28). Patients delayed due to medical reasons had the highest mortality and it is this subset of patients that could potentially benefit the most from earlier surgery.
ASPIRIN AND CLOPIDOGREL
Limited evidence supports not delaying hip fracture surgery for patients on aspirin and/or clopidogrel.

Strength of Recommendation: Limited ★★☆☆☆

RATIONALE
Six low-strength studies (Chechik et al 34, Maheshwari et al 35, Manning et al 36, Thaler et al 37; Hossain et al 38) showed either no difference in outcome or favored not delaying hip fracture surgery in patients on antiplatelet (clopidogrel and/or aspirin) therapy. Previously, some surgeons have delayed surgery for hip fracture patients on Aspirin and/or clopidogrel. This systematic review suggests at worse that there is no advantage to this practice or that in fact the advantage is for patients where surgery is not delayed. The benefit of implementing this recommendation is preventing an unnecessary (unhelpful) delay in performing hip fracture surgery.

ANESTHESIA
Strong evidence supports similar outcomes for general or spinal anesthesia for patients undergoing hip fracture surgery.

Strength of Recommendation: Strong ★★★★★

RATIONALE
Two high strength (Casati et al 39, Davis et al 40) and seven moderate strength (De Visme et al 41, Honkonen et al 42, Koval et al 43, Koval et al 44, McKenzie et al 45, Sutcliffe et al 46, and Valentin et al 47) studies compared spinal anesthesia to general anesthesia in patients undergoing hip fracture surgery.

Meta-analysis showed no difference in mortality. McKenzie et al 45 demonstrated a decreased mortality rate at two weeks post operatively in the spinal anesthesia group; however, this difference did not persist at two months. Valentin et al 47, Sutcliffe et al 46, Davis et al 40 and Koval et al 43 did not demonstrate a difference in mortality between the two groups. De Visme et al 41 and Casati et al 39 found no differences in postoperative confusion.

Casati et al 39, McKenzie et al 45, and Valentin et al 47, demonstrated decreased blood loss in those patients receiving spinal anesthesia. Finally, Koval et al 43, Valentin et al 47, Sutcliffe et al 46, McKenzie et al 45, and Casati et al 39 all did not demonstrate a difference in hospital length of stay.

The work group recognizes that anesthetic techniques described in several of these articles which were published decades ago may have changed when compared with modern methods. In addition, there was significant heterogeneity in the patient populations studied, including multiple studies in which patients were not randomized.
STABLE FEMORAL NECK FRACTURES
Moderate evidence supports operative fixation for patients with stable (non-displaced) femoral neck fractures.

Strength of Recommendation: Moderate ★★★★☆

RATIONALE
One high strength article compared operative to nonoperative treatment for non-displaced femoral neck fractures (Cserhati et al. 48). The major risk factor for non-operative treatment is displacement. It is unclear if this will lead to a more involved treatment such as arthroplasty with higher risks and if the risk-benefit curve favors this approach. There is unique difficulty in determining a truly non-displaced fracture and what patient will benefit from non-operative treatment. Operative treatment typically provides reproducible results with low risk, earlier mobilization and fewer complications.

DISPLACED FEMORAL NECK FRACTURES
Strong evidence supports arthroplasty for patients with unstable (displaced) femoral neck fractures.

Strength of Recommendation: Strong ★★★★★

RATIONALE
Six high strength (Davison et al. 49, Keating et al. 50, Johansson et al. 51, Bray et al. 52, Frihagen et al. 53, and Sikorski et al. 54) and 19 moderate-strength studies (Ravikumar et al. 55, Rogmark et al. 56, Tidermark et al. 57, Chammout et al. 58, Bacharach-Lindstrom et al. 59, Calder et al. 60, El-Abed et al. 61, Johansson et al. 62, Johansson et al. 63, Jonsson et al. 64, Mouzopoulos et al. 65, Neander et al. 66, Parker et al. 67, Parker et al. 68, Parker et al. 69, Roden et al. 70, Skinner et al. 71, Van Dortmont et al. 72, Waaler Bjornelv et al. 73) directly compared arthroplasty (hemi- and/or total hip arthroplasty) to internal fixation for the treatment of unstable/displaced (Garden III and IV) femoral neck fractures in elderly patients. These studies consistently reported better outcomes (reoperation rate, pain scores, functional status, and/or complication rate) for patients in whom internal fixation was avoided as the treatment of choice. A decreased rate of reoperation among patients treated with arthroplasty was the most consistent finding across the studies. A meta-analysis on patients treated with hemiarthroplasty demonstrated no statistically significant difference in mortality (Figure 4).

UNIPOLAR VERSUS BIPOLAR
Moderate evidence supports that the outcomes of unipolar and bipolar hemiarthroplasty for unstable (displaced) femoral neck fractures are similar.

Strength of Recommendation: Moderate ★★★★★
RATIONALE
One high strength study (Davison et al 49) and seven moderate strength (Raia et al 74, Cornell et al 75, Jeffcote et al 76, Calder et al 60, Calder et al 77, Hedbeck et al 78, Kenzora et al 79) Kenzora studies compared unipolar and bipolar hemiarthroplasty for the treatment of displaced femoral neck fractures. All of the included studies showed equivalence in functional and radiographic outcomes, suggesting no significant benefit for bipolar articulation over unipolar hemiarthroplasty for displaced femoral neck fracture. A meta-analysis of mortality at six months and one year show no significant differences between unipolar and bipolar hemiarthroplasty.

HEMI VERSUS TOTAL HIP ARTHROPLASTY
Moderate evidence supports a benefit to total hip arthroplasty in properly selected patients with unstable (displaced) femoral neck fractures.

Strength of Recommendation: Moderate

RATIONALE
One high strength (Keating et al 50) and four moderate strength studies (Blomfeldt et al 80, Hedbeck et al 81, Macaulay et al 82, van den Bekerom et al 83) examined this question. Though various methodologic issues preclude strong recommendations, the evidence on this question generally demonstrates a benefit to patients who received total hip arthroplasty (Hedbeck et al 81, Macaulay et al 82). This benefit was largely manifest in lower pain related scores and lower revision rates for acetabular wear. Mortality rates and infection rates were largely unaffected within the first 4 years after treatment.

However, patient exclusion criteria in some of these studies also reflects the general bias amongst surgeons towards performing total hip arthroplasty in patients who are higher functioning and more likely to be independent community ambulators (Macaulay et al 82). Cautious decision making for lower functioning patients may be justified; studies also demonstrate a higher dislocation rate among total hip arthroplasty patients (van den Bekerom et al 83).

CEMENTED FEMORAL STEMS
Moderate evidence supports the preferential use of cemented femoral stems in patients undergoing arthroplasty for femoral neck fractures.

Strength of Recommendation: Moderate

RATIONALE
Eight moderate strength (Deangelis et al 84, Figved et al 85, Taylor et al 86, Santini et al 87, Lennox et al 88, Parker et al 89, Sonne-Holm et al 90, Singh et al 91) studies address the question of cemented or press fit arthroplasty in the elderly. Randomized controlled trials have largely failed to demonstrate differences (Deangelis et al 84, Figved et al 85), with the exception of fracture risk, which appears to be higher in press fit stems (Taylor et al 86). This remains an infrequent event in other studies. In general, both approaches
yielded acceptable functional results with low complication rates.

**SURGICAL APPROACH**
Moderate evidence supports higher dislocation rates with a posterior approach in the treatment of displaced femoral neck fractures with hip arthroplasty.

**Strength of Recommendation: Moderate**

**RATIONALE**
Two moderate strength articles (Biber et al 92 and Skoldenberg et al 93) compared the posterior approach to the direct lateral approach for arthroplasty in femoral neck fracture surgery. Alternative nomenclature for the posterior approach to the hip identified in the literature includes the Southern, the posterior, the Moore or the dorsal approach. Similarly, the direct lateral approach can also be called the anterolateral, the transgluteal or more commonly the Modified Hardinge approach. While neither of the included studies specifically addressed any functional outcomes, they both demonstrated statistically significant differences in dislocation rates, favoring the Modified Hardinge approach.

**STABLE INTERTROCHANTERIC FRACTURES**
Moderate evidence supports the use of either a sliding hip screw or a cephalomedullary device in patients with stable intertrochanteric fractures.

**Strength of Recommendation: Moderate**

**RATIONALE**
One high quality (Ahrengart et al 94) and two moderate strength (Utrilla et al 95, Varela et al 96) studies compared the use of an extramedullary sliding hip screw device with a cephalomedullary device for stable intertrochanteric fractures. The high strength study compared a cephalomedullary device and sliding hip screw in both stable and unstable intertrochanteric fractures (Ahrengart et al 94). Subgroup evaluation of the stable fractures favored the use of a sliding hip screw with respect to operative time and blood loss. One moderate strength study (Utrilla et al 95) found no difference in walking ability with either a sliding hip screw or cephalomedullary nail for the stable intertrochanteric fractures. The other moderate strength study (Varela et al 96) found no difference in functional outcome, hospital stay, fracture collapse, or mortality between a cephalomedullary nail and an extramedullary sliding hip screw and plate device that offers two points of fixation into the femoral head.

**SUBTROCHANTERIC OR REVERSE OBLIQUITY FRACTURES**
Strong evidence supports using a cephalomedullary device for the treatment of patients with subtrochanteric or reverse obliquity fractures.
Strength of Recommendation: Strong ★★★★

RATIONALE
There were 3 high (Sadowski et al 97, Zhang et al 98, Schipper et al 99), and 2 moderate strength (Miedel et al 100, Hardy et al 101) studies evaluating the use of cephalomedullary devices in the treatment of unstable intertrochanteric and subtrochanteric fractures. Although many comparative studies have been done, the variability of fracture classification systems and implants used makes interpretation of the literature challenging. Evaluation of these studies shows an apparent treatment benefit with cephalomedullary devices for unstable peritrochanteric fractures.

One high strength study (Sadowski et al 97) that specifically evaluated reverse oblique and transverse intertrochanteric fractures (OTA 31.A3) found lower failure rates, blood loss, and operating room time in the cephalomedullary nail cohort versus a 95° fixed-angle device with no difference in functional results. Two high strength comparative studies showed similar results and outcomes between different cephalomedullary devices in unstable fractures (Zhang et al 98, Schipper et al 99).

A moderate strength study (Miedel et al 100) demonstrated a lower complication rate with use of a cephalomedullary versus an extramedullary device in treatment of unstable intertrochanteric and subtrochanteric fractures. Another moderate strength study (Hardy et al 101) showed improved mobility and decreased limb shortening in unstable intertrochanteric fractures treated with a cephalomedullary device versus a sliding hip screw.

UNSTABLE INTERTROCHANTERIC FRACTURES
Moderate evidence supports using a cephalomedullary device for the treatment of patients with unstable intertrochanteric fractures.

Strength of Recommendation: Moderate ★★★★

RATIONALE
Five moderate (Adams et al 102, Knobe et al 103, Papasimos 2005 104, Utrilla et al 95, Leung et al 105) and one high strength (Verettas et al 106) studies evaluated the use of cephalomedullary devices in unstable intertrochanteric fractures with a separate lesser trochanteric fragment but no subtrochanteric involvement (OTA 31.A2). Although many studies have been done, the variability of fracture classification systems and implants used makes interpretation of the literature challenging. Evaluation of these studies shows moderate strength evidence supporting the treatment benefit of cephalomedullary devices for unstable intertrochanteric fractures.

Two moderate strength studies (Utrilla et al 95; Leung et al 105) recommended a cephalomedullary device over sliding hip screw. Utrilla et al 95 found improved postoperative walking ability and fewer blood transfusions in the cephalomedullary group. Leung et al. 105 showed no difference in mortality or ultimate hip function but did
show a shorter convalescence in the cephalomedullary cohort. A high strength study (Verettas et al 106) found no difference in pain and the systemic physiologic responses (O2 requirement, mental status, hematocrit) between treatment with a either sliding hip screw or a cephalomedullary device for this fracture pattern. Similarly, a moderate strength study (Knobe et al 105) found similar mortality and functional results between an extramedullary and a cephalomedullary device. Papasimos et al 104 conducted a moderate strength study evaluating treatment with a sliding hip screw and two different cephalomedullary devices showing no difference between devices with respect to ultimate fracture consolidation and a return to pre-fracture level of function. Adams et al 102 conducted a moderate strength comparative study evaluating a cephalomedullary device to an extramedullary plate and screw including 31.A1, 31.A2 and 31.A3 fractures and found the use of an intramedullary device in the treatment of intertrochanteric femoral fractures is associated with a higher but nonsignificant risk of postoperative complications. By controlling for TAD, there was found to be no statistical difference in the performance of the implants when looking at fracture stability.

VTE PROPHYLAXIS
Moderate evidence supports use of venous thromboembolism prophylaxis (VTE) in hip fracture patients.

Strength of Recommendation: Moderate ★★★★

RATIONALE
One high strength study (PE Prevention Trial Collaborative Group 107), three moderate strength studies (Moskovits et al167; Xabregas et al168; Morris et al169), and eight low strength studies (Chatanaphutiet al 108; Sasaki et al 109; Sasaki et al 110; Checketts et al 111; Jorgensen et al 112; Lahnborg et al 113; Kew et al 114; Eskeland et al 115) were identified comparing various pharmacological prophylaxis interventions to placebo. One moderate strength study (Stranks et al 115) compared mechanical prophylaxis to a group that received no mechanical prophylaxis. These studies show the risk of DVT/VTE/PE complications is significantly less with VTE prophylaxis than control. Most general complications were not significantly different between treatment groups, with the exception of Lahnborg et al 113 which found hematoma complications were higher in pharmacological prophylaxis groups. There was no difference in hospital stay and there is some evidence that mortality is less with prophylaxis.

Given the significant established risk factors for VTE present in this patient population including age, presence of hip fracture, major surgery, delays to surgery, and the potential serious consequences of failure to provide prophylaxis in the hip fracture population, it is the recommendation of the workgroup that VTE prophylaxis be used

TRANSFUSION THRESHOLD
Strong evidence supports a blood transfusion threshold of no higher than 8g/dl in asymptomatic postoperative hip fracture patients.
Strength of Recommendation: Strong

RATIONALE
Two high-strength studies (Carson et al. 116 and Carson et al. 117) support this recommendation. Carson et al. 116 (FOCUS trial) is the largest (n=2016) and most robust study to address transfusion threshold in hip fracture patients. FOCUS considered patient-centered and clinically important outcomes in a prospective, randomized, multicenter, controlled trial. This study showed that a restrictive transfusion threshold of hemoglobin 8g/dl in asymptomatic hip fracture patients with cardiovascular disease or risk factors resulted in no significant difference in primary or secondary outcomes at 30 or 60 days including mortality, independent walking ability, residence, other functional outcomes, cardiovascular events, or length of stay. Carson’s 1998 trial 117 was also a high strength study and was the pilot study that led to FOCUS. Symptoms or signs that were considered indicative of anemia appropriate for transfusion were chest pain that was deemed to be cardiac in origin, congestive heart failure, and unexplained tachycardia or hypotension unresponsive to fluid replacement.

REHABILITATION

SUB-RECOMMENDATION SUMMARY

Occupational and Physical Therapy: Moderate evidence supports supervised occupational and physical therapy across the continuum of care, including home, to improve functional outcomes and fall prevention.

Strength of Recommendation: Moderate

Intensive Physical Therapy: Strong evidence supports intensive home physical therapy to improve functional outcomes.

Strength of Recommendation: Strong

Nutrition: Moderate evidence supports that nutritional supplementation in patients with underlying deficiency improves functional outcomes and reduces mortality; therefore nutritional status should be assessed.

Strength of Recommendation: Moderate

Interdisciplinary Care Program: Strong evidence supports use of an interdisciplinary care program in those patients with mild to moderate dementia who have sustained a hip fracture to improve functional outcomes.

Strength of Recommendation: Strong

OCCUPATIONAL AND PHYSICAL THERAPY

Moderate evidence supports that supervised occupational and physical therapy across the continuum of care, including home, improves functional outcomes and fall prevention.
Strength of Recommendation: Moderate

RATIONALE
Two high-strength studies (Ziden et al 118, Crotty et al 119) and five moderate-strength studies (Binder et al 120, Hagsten et al 121, Hagsten et al 122, Tsauo et al 123, Bischoff-Ferrari et al 124) support that rehabilitative therapies delivered across the continuum of care have been shown to be effective in improving functional outcomes in the elderly patient with hip fracture, post-surgery. Binder et al 120 demonstrated a supervised home-based Physical Therapy (PT) program to be superior to conventional care in improving physical functioning and mobility. Hagsten et al’s studies 121; 122) were moderate strength studies that similarly demonstrated utility of Occupational Therapy (OT) (initiated during hospital stay and continued at home) in improving functional outcomes as measured by Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL) and Health-Related Quality of Life (HRQOL).

Four studies including one high strength (Ziden et al 118) and three moderate strength (Tsauo et al 123; Bischoff-Ferrari et al 124; Ziden et al 125) studies establish the beneficial effects of home-based PT on functional outcomes such as physical and social functioning, ADLs, mobility, HRQOL and patient satisfaction. In addition, Bischoff-Ferrari’s et al 119 study showed reduction in falls although Crotty’s study showed no change in fall rates; however, they demonstrated that accelerated discharge to home-based PT improved level of independence and physical functioning at same levels as hospital-based rehabilitation.

INTENSIVE PHYSICAL THERAPY
Strong evidence supports intensive physical therapy post-discharge to improve functional outcomes in hip fracture patients.

Strength of Recommendation: Strong

RATIONALE
Two high strength (Mangione et al 126; Sylliaas et al 127) and two moderate strength (Allegrante et al 128; Ryan et al 129) studies evaluated benefits of intensive exercise training in elderly patients with hip fracture. Studies support that intensive exercise training administered by physical therapy to patients after discharge from hospital care, improves functional outcomes, leg strength and health status. Sylliaas et al 127 found that a 3-month leg-muscle strength-training program, performed at 70-80% 1-Repetition Maximum, administered at an outpatient rehabilitation clinic, showed improvement in balance, mobility and instrumental ADLs in home-dwelling hip fracture patients postsurgery. Mangione et al 126 found improved leg muscle strength, gait speed, 6-minute walk distance and physical performance scores with intensive leg strengthening exercise training performed by community-dwelling elderly patients, 6-month post hip fracture. Allegrante et al 128 found that high-intensity strength training along with motivational video and peer support, in addition to usual postoperative care, significantly improved
SF-36 scores in the *role-physical* domain functional performance and social functioning. Ryan et al.\(^{129}\) found no significant difference in anxiety/depression scores of recently discharged postoperative hip fracture patients, with augmented in-home therapy compared to conventional care.

**NUTRITION**

Moderate evidence supports that postoperative nutritional supplementation reduces mortality and improves nutritional status in hip fracture patients.

**Strength of Recommendation: Moderate**

**RATIONALE**

One high strength (Duncan et al.\(^{130}\)) and two low strength (Eneroth et al.\(^{131}\) and Espaulella et al.\(^{132}\)) studies were used to evaluate the relationship between nutritional supplementation and outcomes in elderly patients with hip fractures. These studies report that protein energy malnutrition is an important determinant of outcome in older patients with hip fracture. Use of a dietary assistant decreased death acutely 2.5 times (Duncan et al.\(^{130}\)) and at 4 months by half. Duncan et al. is the largest randomized control study of nutritional support following hip fracture and the first that includes patients with cognitive impairment (57%). Energy intake in the intervention group (IV x 3d and PO x 7d) provided by supplements (Eneroth et al.\(^{131}\)) was optimal in 100% of patients in the intervention group vs. 54% in the control group. Fracture related complication rate was 15% (intervention group) vs. 70% (control group). Greater than 58% of the patients in each group were malnourished on admission. A 20g protein supplement daily with 800mg of calcium did not decrease mortality or increase functional status but significantly decreased complications within the hospital (odds ratio 1.88 in-hospital and overall 1.94 after discharge (Espaulella et al.\(^{132}\)).

**INTERDISCIPLINARY CARE PROGRAM**

Strong evidence supports use of an interdisciplinary care program in those patients with mild to moderate dementia who have sustained a hip fracture to improve functional outcomes.

**Strength of Recommendation: Strong**

**RATIONALE**

Two high strength (Berggren et al.\(^{133}\) and Marcantonio et al.\(^{134}\)), and seven moderate strength (Huusko et al.\(^{135}\), Huusko et al.\(^{136}\), Krichbaum et al.\(^{137}\), Shyu et al.\(^{138-140}\), Stenvall et al.\(^{141}\)), studies found that an interdisciplinary rehabilitative program achieved better functional outcomes and fall prevention in post-surgical hip fracture patients. The most differences were found in the group of patients having mild to moderate dementia (Huusko et al.\(^{135}\); and Shyu et al.\(^{138-140}\)).
The elements of the interdisciplinary rehabilitative programs varied minimally in the studies reviewed. For example, Shyu et al’s study\(^{140}\) included geriatric consultation, rehabilitative services, discharge planning and post-hospital services, while Berggren et al’s\(^{133}\) study included geriatric assessment, rehabilitation and active detection, prevention and treatment of fall risk factors.

**POSTOPERATIVE MULTIMODAL ANALGESIA**

Strong evidence supports multimodal pain management after hip fracture surgery.

**Strength of Recommendation: Strong ★★★★★**

**RATIONALE**

Five high strength (Mouzopoulos et al\(^{14}\), Matot et al\(^{16}\), Lamb et al\(^{142}\), Kang et al\(^{143}\), Gorodetskyi et al\(^{144}\)) and five moderate strength (Bech et al\(^{146}\), Foss et al\(^{146}\), Ogilvie-Harris et al\(^{147}\), Spansberg et al\(^{148}\), Tuncer et al\(^{149}\)) studies support this recommendation. Neurostimulation, local anesthetics, regional anesthetics, epidural anesthetics, relaxation, combination techniques, and pain protocols have been shown to reduce pain as well as improve satisfaction, improve function, reduce complications, reduce nausea and vomiting, reduce delirium, decrease cardiovascular events, and reduce opiate utilization. There are a large variety of techniques that result in modest but significant positive improvements in many clinical and patient-centered domains with minimal significant adverse outcomes noted. While no particular technique is recommended, using an array of pain management modalities is appropriate.

**CALCIUM AND VITAMIN D AND SCREENING**

**Calcium and Vitamin D:** Moderate evidence supports use of supplemental vitamin D and calcium in patients following hip fracture surgery.

**Strength of Recommendation: Moderate ★★★★**

**Screening:** Limited evidence supports preoperative assessment of serum levels of albumin and creatinine for risk assessment of hip fracture patients.

**Strength of Recommendation: Limited ★★★★**

**CALCIUM AND VITAMIN D**

Moderate evidence supports use of supplemental vitamin D and calcium in patients following hip fracture surgery.

**Strength of Recommendation: Moderate ★★★★**

**RATIONALE**

Four moderate strength studies (Bischoff-Ferrari et al\(^{150}\), Prince et al\(^{151}\), Harwood et al\(^{152}\), and Chapuy et al\(^{153}\)) show benefits of either supplemental calcium, vitamin D or
both to reduce fall risk and prevent fractures in the elderly. There is a high prevalence of vitamin D deficiency among hip fracture patients (Bischoff-Ferrari et al\textsuperscript{150}) and hip fracture patients have a 5-10x increased risk of a second hip fracture and other fragility fractures (Harwood et al\textsuperscript{152}). In a moderate strength double-blinded study in elderly women with hip fractures (Bischoff-Ferrari et al), 98% of patients were found to be vitamin D deficient (<30 ng/ml) and hospital readmission rates were decreased by 39% in patients treated with daily supplementation of 2000 IU versus 800 IU vitamin D. In a moderate strength randomized clinical trial in 3,270 elderly women, Chapuy et al\textsuperscript{153} showed that supplemental calcium and 800 IU vitamin D reduced the risk of hip fractures by 43% and non-spine fractures by 32% over 18 months. Another moderate strength 5 year double-blind placebo-controlled study (Prince et al\textsuperscript{151}) showed a reduction in fractures in the elderly population with supplemental calcium carbonate (1200mg/d), but the results were limited due to poor long term compliance. A randomized controlled trial of hip fracture patients (Harwood et al\textsuperscript{152}) showed vitamin D supplementation either orally or by injection increased bone mineral density and reduced the incidence of falls, with calcium co-supplementation having a positive effect.

SCREENING
Limited evidence supports preoperative assessment of serum levels of albumin and creatinine for risk assessment of hip fracture patients.

Strength of Recommendation: Limited ★★★★★

RATIONALE

There was one moderate strength (Mosfeldt et al\textsuperscript{156}) and four low strength prognostic studies assessing the effect of albumin levels on patient outcomes after hip fracture surgery (Burness et al\textsuperscript{154}, Forminga et al\textsuperscript{155}, Ozturk et al\textsuperscript{157} and Lieberman et al\textsuperscript{158}). Low albumin levels had a statistically significant positive correlation with mortality in three studies (Burness et al\textsuperscript{154}, Mosfeldt et al\textsuperscript{156}, Ozturk et al\textsuperscript{157}). Lieberman et al found that a 1 g/DL increase in serum albumin at discharge was associated with an 8.4% improvement on the Functional Independence Measure after rehabilitation was complete. Finally, Forminga et al\textsuperscript{155} found that low albumin levels were associated with a higher risk of nosocomial infection and pressure ulcers.

Three low strength prognostic studies assessed the effect of patient creatinine levels on outcomes after hip fracture surgery (Talsnes et al\textsuperscript{159}, Bjorkelund et al\textsuperscript{160}, Mosfeldt et al\textsuperscript{156}). Talsnes et al\textsuperscript{159} found elevated creatinine levels on the 1st post-op day significantly increased the odds of mortality, but pre-op levels and day 4 post-op levels were not significant predictors of death. Finally Bjorkelund et al\textsuperscript{160} did not find creatinine levels of >100 g/L to be significantly associated with post-op confusion, in-hospital complications or length of hospital stay beyond 10 days.

OSTEOPOROSIS EVALUATION AND TREATMENT
Moderate evidence supports that patients be evaluated and treated for osteoporosis after sustaining a hip fracture.
RATIONALE
There were two moderate strength studies (Lyles et al161 and Majumdar et al162) and one low strength studies (Gardner et al163) that support this recommendation. Lyles et al161 studied the effectiveness of zoledronic acid versus placebo combined with pre-treatment vitamin D repletion and found that the treatment group exhibited statistically significant reductions in mortality rates, rates of any new fractures, rates of new non-vertebral fractures, or the rates of new vertebral fractures. All participants who had very low 25-hydroxyvitamin D levels or no blood level available received 50,000 to 125,000 units of vitamin D2 or D3 (orally or intramuscularly) 14 days before the treatment intervention. All participants then received supplemental calcium and vitamin D daily. Majumdar et al162 was upgraded from a low strength study to a moderate strength study due to a large effect size. Majumdar, et al studied the effectiveness of an osteoporosis case manager for post-discharge hip fracture care. In this study, those patients who received the intervention had increased chance of osteoporosis evaluation by bone mineral density testing and osteoporosis-specific treatment with bisphosphonates. The Gardner et al163 study found no significant differences in mortality or osteoporosis addressed with bone density scan and/or bisphosphonate therapy between the group who received a discussion regarding osteoporosis risks post-surgery and the group who received a fall prevention pamphlet. Hip fractures are a sign (symptom) of osteoporosis, but most patients with hip fractures are not currently evaluated and treated for their underlying osteoporosis.