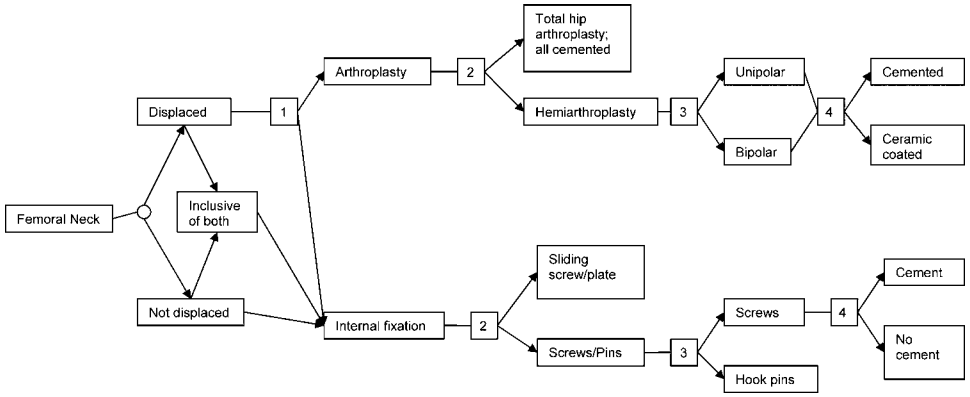

Fig. E-1

Implant aggregation diagram showing femoral neck decision tree-literature map.

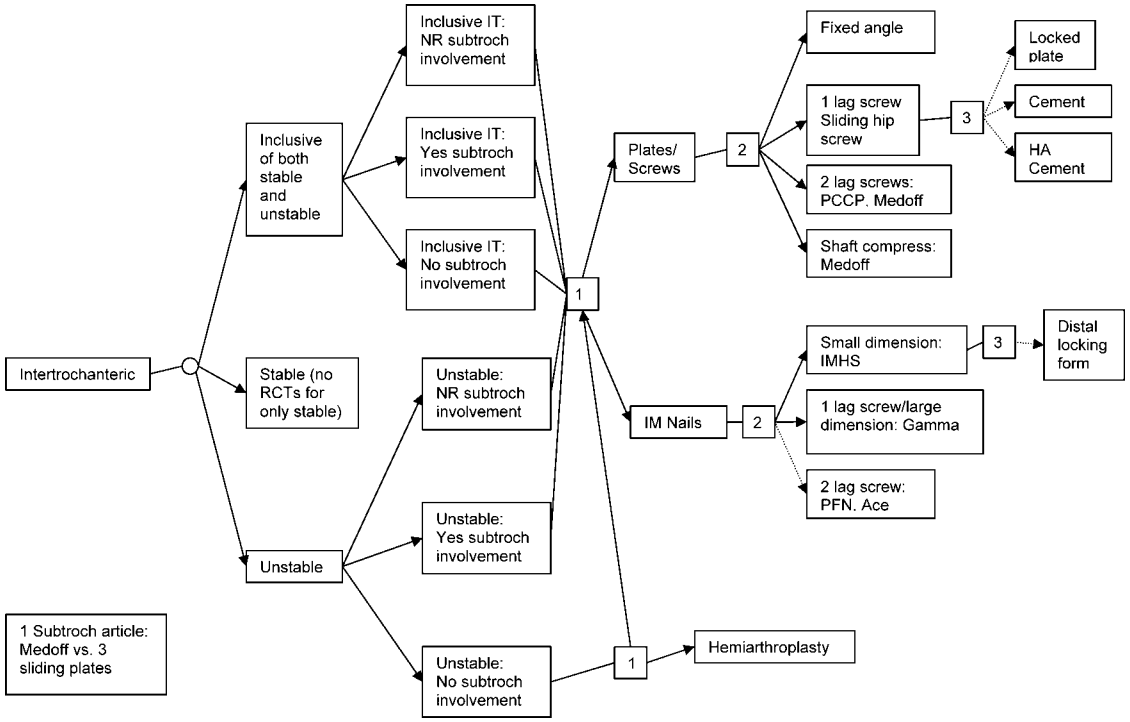

Fig. E-2

Implant aggregation diagram showing pertrochanteric decision tree-literature map. IT = intertrochanteric, NR = not reported, RCT = randomized controlled trial, IM = intramedullary, IMHS = intramedullary hip screw, PFN = proximal femoral nail, HA = hydroxyapatite, and PCCP = percutaneous compression plate.

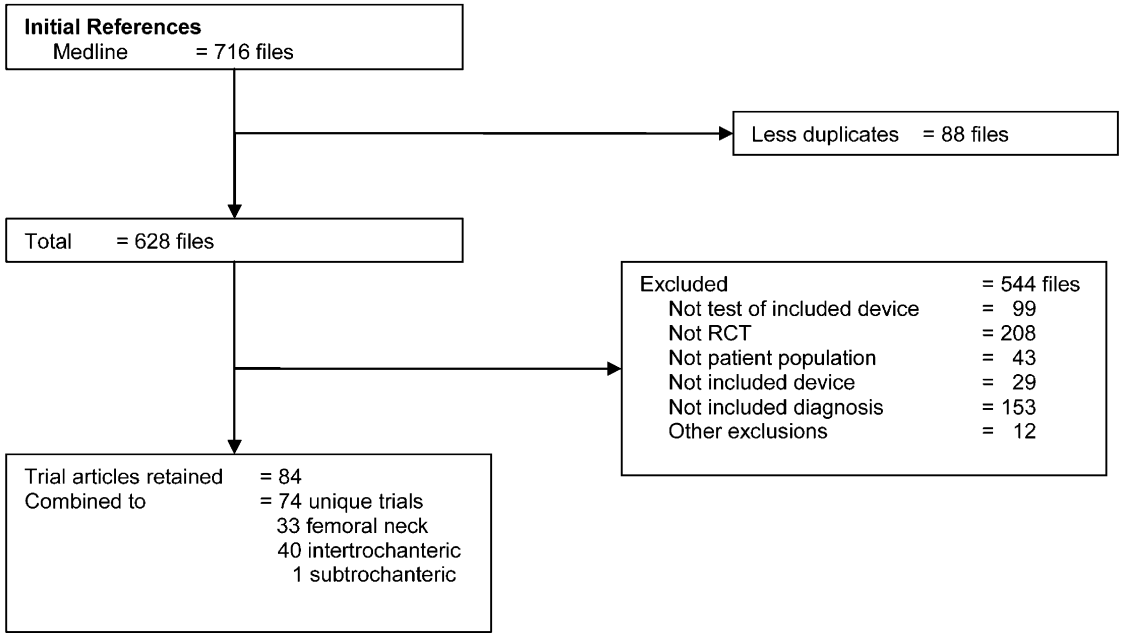

Fig. E-3

Study inclusion by search flow (QUORUM): randomized clinical trial literature. QUORUM = Quality of Reporting of Meta-analyses, and RCT = randomized controlled trial.

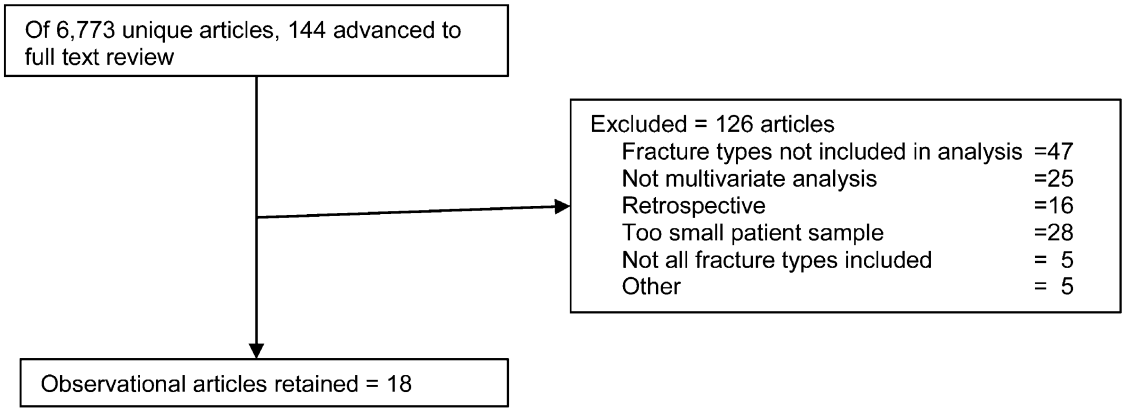

Fig. E-4

Study inclusion by search flow (QUORUM): observational literature. QUORUM = Quality of Reporting of Meta-analyses.

TABLE E-1 Devices Included in this Systematic Literature Review 1985-2008*

Included Device	Included RCT Articles in which Device was Tested
Intertrochanteric hip fractures	
Extramedullary	
Sliding hip screw (SHS) includes Dynamic Hip Screw (DHS), Compression Hip Screw (CHS)	Papasimos, 2005[168], Utrilla, 2005[82], Mattsson, 2004[162], Pajarinen, 2004[169], Moroni, 2004[100], Peyser, 2007[76], Mattsson, 2005[101], Pajarinen, 2005[84], Ahrengart, 2002[86], Saudan, 2002[92], Brandt, 2002[165], Harrington, 2002[95], Kosygan, 2002[78], Janzing, 2002[79], Dujardin, 2001[172], Adams, 2001[93], Olsson, 2001[77], Lunsjö, 2001[80], Lunsjö, 1999[171], Park, 1998[166], Madsen, 1998[173], Hardy, 1998[87], Baumgaertner, 1998[46], Watson, 1998[47], Hoffman, 1996[88], Elmerson, 1995[60], Butt, 1995[89], O'Brien, 1995[83], Stappaerts, 1995[170], Goldhagen, 1994[49], Aune, 1994[167], van Vugt, 1993[70], Radford, 1993[85], Leung, 1992[90], Bridle, 1991[91], Skinner, 1989[62], Madsen, 1987[151], Linde, 1986[152]
SHS used in femoral neck studies	El-Abed, 2005[71], Davison, 2001[67], Ravikumar, 2000[65], Benterud, 1997[59], Kuokkanen, 1991[174], Paus, 1986[54]
DHS with Trochanter Stabilizing Plate (TSP)	Lunsjö, 2001[80], Lunsjö, 1999[171], Madsen, 1998[173]
Gotfried Percutaneous Compression Plate (PCCP)	Peyser, 2007[76], Brandt, 2002[165], Kosygan, 2002[78], Janzing, 2002[79]
Medoff sliding plate (multiple versions with different numbers of holes)	Ekström, 2007[94], Miedel, 2005[96], Olsson, 2001[77], Lunsjö, 2001[80], Lunsjö, 1999[171], Buciuto, 1998[175]
Dynamic Condylar Screw (DCS) (95° fixed angle plate)	Sadowski, 2002[97], Lunsjö, 2001[80], Lunsjö, 1999[171]
Minimally invasive percutaneous plate osteosynthesis (MIPPA) using DCS	Dujardin, 2001[172]
Intramedullary	
Gamma nail (first, second, third generation)	Efstathopoulos, 2007[102], Miedel, 2005[96], Schipper, 2004[30], Herrera, 2002[164], Ahrengart, 2002[86], Adams, 2001[93], Fritz, 1999[81], Madsen, 1998[173], Hoffman, 1996[88], Butt, 1995[89], Goldhagen, 1994[49], Aune, 1994[167], Radford, 1993[85], Leung, 1992[90], Bridle, 1991[91]
Asian Gamma nail, or Gamma AP	Vidyadhara, 2007[103], Park, 1998[166]
Intermedullary Hip Screw (IMHS)	Hardy, 2003[104], Harrington, 2002[95], Hardy, 1998[87], Baumgaertner, 1998[46]
Proximal Femoral Nail (PFN)	Ekström, 2007[94], Papasimos, 2005[168], Kim, 2005[98], Pajarinen,

	2004[169], Pajarinen, 2005[84], Schipper, 2004[30], Herrera, 2002[164], Saudan, 2002[92], Sadowski, 2002[97]
Gliding nail	Fritz, 1999[81]
ACE trochanteric nail	Vidyadhara, 2007[103], Efstathopoulos, 2007[102]
Femoral neck fractures	
Hansson hook pin (LIH pin) (6.5-mm smooth pin with hook extruded at tip)	Mjørud, 2006[55], Lykke, 2003[56], Elmerson, 1995[60], Jónsson, 1996[73], Herngren, 1992[57], Olerud, 1991[58]
Thornton nail (flanged trifin cannulated nail)	Jacobsson, 1985[176]
Uppsala screws (8-mm cancellous screw with 6-mm shank)	Lagerby, 1998[150], Herngren, 1992[57], 662, 675
Von Bahr screws (7-mm cancellous screw with 5.5-mm shank)	Rödén, 2003[72], Rehnberg, 1989[53], Paus, 1986[54]
Mecron screws	Kuokkanen, 1991[174]
AO screws	Mjørud, 2006[55], Parker, 2002[156], Parker, 2000[68], van Dortmont, 2000[69], Madsen, 1987[151], Linde, 1986[152]
Olmed screws (6-mm shank and 8-mm threads)	Mattsson, 2006[148], Johansson, 2006[157], Blomfeldt, 2005[74], Mattsson, 2003[149], Tidermark, 2003[160], Tidermark, 2003[161], Johansson, 2001[159], Johansson, 2000[99], Bachrach-Lindström, 2000[158], Benterud, 1997[59], Neander, 1997[177]
Ullevaal screw (7-mm shank and 7-mm cancellous thread)	Lykke, 2003[56], Puolakka, 2001[66]
Scand pin (6.5-mm cancellous threaded screw)	Jacobsson, 1985[176]
“Cannulated screws” (DePuy/Johnson & Johnson)	Blomfeldt, 2005[155]
Richards screw (4.8-mm shaft, 6.86-mm thread)	Lagerby, 1998[150]
Hemiarthroplasty	
Thompson unipolar (cemented and uncemented)	Puolakka, 2001[66], Davison, 2001[67], van Dortmont, 2000[69], Emery, 1991[146]
Endo femoral head (Zimmer) with Zimmer CPT stem	Baker, 2006[63]
Unitrax unipolar	Raia, 2003[51]
Centrax bipolar	Raia, 2003[51]
Moore unipolar (uncemented)	Skinner, 1989[62]
Austin Moore unipolar (uncemented)	El-Abed, 2005[71], Blomfeldt, 2005[155], Parker, 2002[156], Ravikumar, 2000[65], Christie, 1994[178], Emery, 1991[146]
Monk bipolar (cemented)	Davison, 2001[67]
Varikopf bipolar	Rödén, 2003[72]
Mallory head calcar replacement system	Kim, 2005[98]

Vandeputte (VDP) endoprosthesis	Stappaerts, 1995[170]
Bipolar Stanmore variocup	van Vugt, 1993[70]
Exeter modular stem (28 mm head, OGEE acetabular component) bipolar hemi or total hip replacement	Blomfeldt, 2007[61], Blomfeldt, 2005[74], Tidermark, 2003[160], Tidermark, 2003[161]
ODC modular femoral components	Cornell, 1998[48]
Total Hip Replacement	
Charnley system	Jónsson, 1996[73]
Zimmer system (acetabular cup with CPT stem)	Baker, 2006[63]
Lubinus system	Johansson, 2006[157], Johansson, 2001[159], Johansson, 2000[99]
BiMetric	Neander, 1997[177]
Howse II	Ravikumar, 2000[65], Skinner, 1989[62]

*RCT = randomized controlled trial.

TABLE E-2 Nonmortality Outcomes Reported in the Hip Fracture Literature, 1985-2008

Outcome	Articles*
Function – Femoral Neck	
6-minute walk	Cornell, 1998[48]
Walking distance in miles	Baker, 2006[63]
Walking distance 1 kilometer or more	Jónsson, 1996[73]
Walking ability: no aid, with aids, not walking, unknown	Mjørud, 2006[55] (no data)
Walking: 1 cane or less outdoors	Jónsson, 1996[73]
Walking: 1 or no aids, 2 canes or more, not ambulatory	Lagerby, 1998[150]
Walk without or 1 stick, walk with aid, not walking	Olerud, 1991[58] (no data), Rehnberg, 1989[53]
Return to same walking aid use: none, walking stick, walking frame (Zimmer), immobile	Parker, 2002[156], Parker, 2000[68], Paus, 1986[54] (no data)
Return to prefracture walking	Rödén, 2003[72]
Independent of aids (no specifics)	Emery, 1991[146]
Mobility: Independent (does shopping), independent with aids, housebound unless accompanied, uses aids indoors, chair or bedbound	Ravikumar, 2000[65] (insufficient data), Skinner, 1989[62] (no data)
"Get up and go"	Cornell, 1998[48]
Activities of Daily Living (ADL) (no specifics)	Mattsson, 2006[148]
ADL independence on at least 5 functions	Blomfeldt, 2005[74], Blomfeldt, 2007[61], Blomfeldt, 2005[155]
Able to do own shopping	Jónsson, 1996[73]
Able to go shopping	Livesley, 1993[147]
Home assistance less than 4 hours weekly	Jónsson, 1996[73]
Oxford hip (global)	Baker, 2006[63]
Merle D'Aubigne mobility scale (passive, 6 increments of mobility)	Mattsson, 2006[148] (no data)
Musculoskeletal functional assessment: mobility and activities of daily living	Raia, 2003[51] (insufficient data)
Parker/Palmer mobility score	Parker, 2002[156], Parker, 2000[68] (insufficient data)
Harris hip score (global)	Johansson, 2006[157] (insufficient data), Davison, 2001[67] (insufficient data), Johansson, 2000[99] (insufficient data), Ravikumar, 2000[65] (insufficient data), Kuokkanen, 1991[174]
Harris hip score subscales: pain, function, absence of deformity,	Blomfeldt, 2007[61]

range of motion	
Hip rating questionnaire. 100-point scale equal weight to global, pain, walking, function.	Keating, 2006[64]
Charnley score: pain, movement, walking	Blomfeldt, 2005[74] (insufficient data), Blomfeldt, 2005[155]
Matta scoring system: (global) pain, ambulation, range of motion - surgeon rated	El-Abed, 2005[71]
Barthel index (based on activities of daily living, maximum score of 20)	Davison, 2001[67]
Johansen hip score	Cornell, 1998[48]
Patient's opinion of hip, rest pain, pain rising from chair, activity pain, hip flexion, ability to climb stairs, assistance walking, activity	Livesley, 1993[147]
Return to preinjury state (no specifics)	Davison, 2001[67]
Function – Pertrochanteric	
Walking: able to walk without aids or 1 stick, walk with aids, walk when assisted by another person	Vidyadhara, 2007[103], Pajarinen, 2005[84]
Walking aids (no specifics)	Ahrengart, 2002[86]
Walking: no aid or 1 stick (%)	Adams, 2001[93]
Walking: no aids, aids, nonwalker	Lunsjö, 1999[171], Leung, 1992[90]
Walking: without help, with aid, wheelchair/bedridden	Janzing, 2002[79]
Walking: 0-6 scale from no support to bedridden or needing a wheelchair	Park, 1998[166]
Walking 1.5 miles	Ekström, 2007[94]
Ambulation: community, community with aid, household	Goldhagen, 1994[49]
Recovery of walking to preop. status (%)	Efstathopoulos, 2007[102], Pajarinen, 2005[84]
Return to pre-injury living (ambulation) status: community, household, nonambulatory	Harrington, 2002[95]
Return to independent walker (no specifics)	Olsson, 2001[77], Lunsjö, 2001[80]
Rise from chair without arm support	Ekström, 2007[94], Mattsson, 2005[101]
Climb a 15-cm curb	Ekström, 2007[94], Mattsson, 2005[101]
Katz activities of daily living: A indicating independent in all; B, independence in all but one; and C-G, dependence in bathing and at least one other function	Miedel, 2005[96]

ADL scale (global)	Kim, 2005[98]
ADL individual components	Mattsson, 2005[101] (no data)
Weight-bearing score (single leg)	Peyser, 2007[76]
Mobility scores (no specifics)	Efstathopoulos, 2007[102]
Harris hip score (global)	Vidyadhara, 2007[103], Kim, 2005[98] Moroni, 2004[100], Schipper, 2004[30], Adams, 2001[93] (insufficient data)
Salvati and Wilson score: pain, walking ability, muscle power-motion, overall function	Papasimos, 2005[168] (insufficient data)
Parker and Palmer mobility score (global)	Utrilla, 2005[82], Hardy, 2003[104] (insufficient data), Saudan, 2002[92], Sadowski, 2002[97], Hardy, 1998[87]
Parker and Palmer mobility subscales: hip pain, thigh pain, walking	Utrilla, 2005[82]
Charnley: pain, movement, walking ability (subscales)	Miedel, 2005[96] (insufficient data)
Merle d'Aubigne: pain, walking, mobility subscales	Fritz, 1999[81] (insufficient data)
Pain – Femoral Neck	
Visual analog scale (VAS) pain score	Mattsson, 2006[148]
Charnley pain score	Parker, 2002[156], Parker, 2000[68] (insufficient data)
Little or no pain (no specifics)	Lykke, 2003[56] (no data), Parker, 2002[156], Parker, 2000[68] (insufficient data)
Degree of walking or passive joint motion pain (no specifics)	Lagerby, 1998[150]
No pain at rest	Jónsson, 1996[73]
No pain when walking	Jónsson, 1996[73]
No use of analgesics	Rödén, 2003[72], Jónsson, 1996[73]
Pain/no pain (no specifics)	Emery, 1991[146]
Pain: none, on weight-bearing, constant	Olerud, 1991[58], Rehnberg, 1989[53]
Pain: no analgesics, occasional use, regular use	Ravikumar, 2000[65] (insufficient data), Skinner, 1989[62]
Pain – Pertrochanteric	
Hip pain (no specifics)	Vidyadhara, 2007[103], Utrilla, 2005[82], Baumgaertner, 1998[46], Leung, 1992[90]
Hip pain while walking (no specifics)	Hardy, 1998[87]
Thigh pain (no specifics)	Vidyadhara, 2007[103], Utrilla, 2005[82], Hardy, 2003[104], Leung, 1992[90]
Thigh pain while walking (no specifics)	Hardy, 1998[87]

VAS score for pain at rest	Ekström, 2007[94] (insufficient data), Mattsson, 2005[101]
VAS pain initiating walking	Ekström, 2007[94] (insufficient data)
VAS pain while walking (10 ft, 50 ft)	Ekström, 2007[94] (insufficient data), Mattsson, 2005[101]
VAS pain in single-leg stance	Peyser, 2007[76]
Hip or thigh pain: 4 levels, no pain to severe pain at rest requiring medication (continuous)	Saudan, 2002[92], Sadowski 2002[97]
Resolution of hip pain	Hoffman, 1996[88]
Lateral pain over femoral head screw	Ahrengart, 2002[86]
Pain at top of greater trochanter	Ahrengart, 2002[86]
Quality of Life – Femoral Neck	
Short Form-36 (SF-36)	Baker, 2006[63], El-Abed, 2005[71], Raia, 2003[51] (insufficient data)
EQ-5D Euro-QoL	Keating, 2006[64], Blomfeldt, 2005[74] (no data), Blomfeldt, 2007[61] (no data), Blomfeldt, 2005[155] (no data)
Quality of Life – Pertrochanteric	
SF-36 (global)	Moroni, 2004[100]
SF-36 (subscales)	Mattsson, 2005[101] (insufficient data)
EQ-5D (subscales)	Miedel, 2005[96] (insufficient data)
Jensen social function	Hardy, 2003[104] (no data), Saudan, 2002[92], Sadowski, 2002[97]
Residence – Femoral Neck	
Residence: home, sheltered home, nursing home (NH), hospital	Livesley, 1993[147]
Living condition: independent vs. NH	Mjørud, 2006[55] (no data), Blomfeldt, 2007[61]
Living in own home	Lykke, 2003[56], Parker, 2002[156], Parker, 2000[68], Olerud, 1991[58] (no data), Rehnberg, 1989[53]
Living situation: alone, with family, sheltered home	Emery, 1991[146]
Return to original residence	Rödén, 2003[72]
Residence – Pertrochanteric	
Living condition: own home, NH, institution	Ekström, 2007[94] (insufficient data), Pajarinen, 2005[84]
Living condition: own home, not at home/institution	Utrilla, 2005[82], Ahrengart, 2002[86], Saudan, 2002[92], Sadowski, 2002[97], Adams, 2001[93], Fritz, 1999[81] (insufficient data)
Recovery of ability to preop. level (%)	Pajarinen, 2005[84]
Accommodation (no specifics)	Hardy, 2003[104] (no data)
Residence: independent, family/old people's home, NH/hospital	Janzing, 2002[79], Lunsjö, 2001[80], Lunsjö, 1999[171]
Returned to own home	Ekström, 2007[94] (insufficient data), Olsson, 2001[77]

*No data = article provided a summary statement regarding significance for the outcome, but did not provide supporting data.
Insufficient data = article did not provide the full complement of data necessary for quantitative analysis.

TABLE E-3 Femoral Neck Fracture Randomized Trial Evidence Table, Part 1

Author, Year	Comparison	Country	No. Enrolled	Inclusion	Exclusion	Exclusion Problems	Average Age, Range or SD, and % Female
Node 4 Displaced – Arthroplasty – Hemi Choices							
Emery, 1991[146]	Cemented stem vs. uncemented, bipolar hemi	England	53	Active, independently mobile with displaced femoral neck fracture	Admitted from NH, use more than one walking stick	Bilateral, non-index, cancer not reported	79, 61-96, 87%
Livesley, 1993[147]	Ceramic coated vs. not, bipolar hemi	United Kingdom	82	Displaced femoral neck fracture	None listed	Bilateral, non-index, cancer not reported	81, SD 7.8, NR
Node 4 Displaced – Internal Fixation – Cemented vs. Uncemented Screws							
Mattsson, 2006[148]	IF - Calcium phosphate vs. no calcium phosphate	Sweden	118	Displaced femoral neck fracture, ambulatory without walking aid (or with one cane), 60+ years of age, surgical procedure within	Senility, earlier hip surgery, soft-tissue infection at operative site, ongoing radiation therapy or chemotherapy due to malignancy, pathological		NR, 60-98, 81%

				72 hours of admission, normal contralateral hip	fracture, clotting disorder, corticosteroid treatment of >5 mg per day, concurrent fracture that would affect postoperative functional outcome, serious concomitant illness or mental instability, neurosensory, neuromuscular or musculoskeletal deficiency that might limit ability to perform objective functional tests		
Mattson, 2003[149]	IF - Calcium phosphate vs. no calcium phosphate	Sweden	40	Low-energy trauma, prefracture ambulatory without aid (or with one cane)	Senility, pathological fracture, concurrent fracture, bilateral	Bilateral, non-index, cancer not reported	78, 62-92, 83%
Node 3 Displaced – Arthroplasty – Unipolar vs. Bipolar Hemiarthroplasty							

Raia, 2003[51]	Unipolar vs. bipolar hemi (cemented stems)	United States	115	65+ years with displaced femoral fracture, ambulatory	Dementia, pathologic fracture, concurrent lower-extremity fracture, NH residence	Bilateral, non-index, cancer not reported	82, 65-101, 72%
Cornell, 1998[48]	Unipolar vs. bipolar hemi (cemented stems)	United States	48	65+ with displaced femoral neck fracture (early results but full study not reported)	Previous ipsilateral hip surgery, pathological fracture, mentally incompetent patients	Bilateral, non-index not reported	78, 62-97, 75%
Node 3 Inclusive – Internal Fixation – Hook Pins vs. Screws							
Mjørud, 2006[55]	IF - 2 hook pins vs. 3 screws	Sweden	199	Cervical hip fracture	Nonhealed bilateral, pathological fracture, combined with trochanteric component, joint disease, unable to reduce satisfactorily	3 high-energy trauma; other concomitant fracture	Undisplaced 79, displaced 81, undisplaced age range 28-101, displaced 53-101, 76% female
Lykke, 2003[56]	IF - 2 hook pins vs. 3 screws	Norway	278	Femoral neck fracture	Bilateral, pathological fracture, concomitant or combined fractures, irreducible fractures	High-energy trauma, non-index, cancer not reported	82, 27-101, 82%
Herngren,	IF - 2 hook	Sweden	179	Femoral neck	Pathologic	1 bilateral.	78, 28-97,

1992[57]	pins vs. 2 screws			fractures	fractures, unable to reduce satisfactorily	High-energy trauma, non-index, cancer not reported	63%
Olerud, 1991[58]	IF - 2 hook pins vs. 2 screws	Sweden	115	Femoral neck fractures	None listed	Bilateral, non-index, cancer not reported	80, SD 9, 84%
Node 3 Inclusive – Internal Fixation - Screws vs. Screws							
Lagerby, 1998[150]	IF - 2 vs. 3 screws	Sweden	268	Femoral neck fractures	Pathological fractures	2 bilateral cases. High trauma, non-index not mentioned	81, 31-99, 67%
Rehnberg, 1989[53]	IF - 2 vs. 2 screws	Sweden	222	Femoral neck fracture	Pathologic fractures, unable to reduce satisfactorily, fracture older than 1 week	Bilateral, non-index, cancer not reported	80, 55-98, 75%
Node 2 Displaced – Arthroplasty – Hemi vs. THA							
Baker, 2006[63]	Hemi (cemented unipolar) vs. THA	United Kingdom	81	60+ years with displaced femoral neck fracture, able to walk >0.5 mile, living	Cognitive difficulty, pathological fracture, osteoarthritis, hip		75, 63-86, 80%

				independently	abnormality requiring THA (no bilateral, non-index)		
Blomfeldt, 2007[61]	Hemi (cemented bipolar) vs. THA	Sweden	120	70 to 90 years, acute displaced femoral neck fracture following a fall, no severe cognitive dysfunction, independent living status, prefracture ambulatory with or without aids	Pathological fracture, fractured >48 hr prior, rheumatoid or osteoarthritis	Bilateral, non-index, cancer, trauma not reported	81, 70-90, 84%
Node 2 Displaced – Internal Fixation – Pins/Screws vs. Plate and Screws							
Benterud, 1997[59]	IF - Sliding screw plate plus screw vs. 2 screws	Sweden	225	Displaced femoral neck fracture, 70+ years, but younger included	None listed	Figures given prior to exclusion from randomization	81, 63-97, 79%
Madsen, 1987[151], and Linde, 1986[152]	IF - Sliding screw plate vs. 4 screws	Norway	103	Displaced femoral neck fractures	Pathologic fractures, >24-hr delay to surgery for Garden stage 4	High-energy trauma, bilateral, non-index, cancer not reported	75, 25-92, 76%
Paus, 1986[54]	IF - Hip	Denmark	131	<80 years with	None listed	High-energy	70 women,

	compression screw vs. 2 screws			displaced femoral neck fractures		trauma, bilateral, non-index, cancer not reported	64 men, NR, 82%
Elmerson, 1995[60]	IF - Sliding screw plate vs. 2 hook pin	Sweden	248	Femoral neck fracture	Pathological fractures, unable to reduce fracture	Bilateral, non-index, cancer not reported	77, NR, prior to exclusion 50-99, 76%
Node 1 Displaced – Internal Fixation vs. Hemi vs. THA							
Skinner, 1989[62] Ravikumar, 2000[65]	IF vs. hemi vs. THA	United Kingdom	278	65+ years with displaced femoral fracture (may not include total hip arthroplasty)	None listed	Bilateral, non-index, cancer not reported	81, NR, 90%
Keating, 2006[64], and Keating, 2005[75]	IF vs. hemi vs. THA (mixed bag)	Scotland	299	Mini-mental test score of >6, prefracture ability to be mobile independent of another person, no serious concomitant disease (or other clinical reason for exclusion), surgeon determination if treatment options suitable	Undisplaced or valgus impacted intracapsular fracture. Surgeon decided clinical eligibility and whether to assign to 2-way or 3-way randomization (double counting of patients)	Bilateral and non-index not reported	75, NR, 60+ years, 78%

Rogmark, 2002[153], and Rogmark, 2003[154]	IF vs. arthroplasty (various types)	Sweden	409	70+ with displaced femoral neck fracture	Confusion, rheumatoid arthritis, bedridden, NH residence	Bilateral, non-index, cancer not reported	82, SD 5.8, 79%
Node 1 Displaced – Internal Fixation vs. Hemi							
El-Abed, 2005[71]	IF (DHS) vs. uncemented unipolar hemi	Ireland	122	70+ with displaced femoral neck fracture	Nondisplaced fractures, pathological fractures, and mental confusion, bedridden.	Bilateral, non-index, cancer, trauma not reported	73, 70-87, 67%
Davison, 2001[67]	IF (CHS) vs. hemi, cemented unipolar and bipolar	United Kingdom	280	Age between 65 and 79 years with displaced femoral neck fracture	Cognitive difficulty, pathological fracture, rheumatoid arthritis, long-term steroid therapy	Bilateral, non-index not reported	75, 70-78, 76%
Blomfeldt, 2005[155]	IF (2 screws) vs. uncemented unipolar hemi	Sweden	60	Displaced femoral neck fracture due to fall, 70+ years old, diagnosed with dementia and/or severe cognitive dysfunction, mobile with or without aid	Pathological fracture, displaced fractures of >24 hr, rheumatoid or osteoarthritis, inability to reduce	Bilateral, non-index, cancer not reported	84, 70-96, 90%
Rödén,	IF (2 screws)	Sweden	100	70+, ambulatory,	Medical findings,	Bilateral, non-	81, 70-96,

2003[72]	vs. cemented bipolar hemi			with displaced femoral neck fractures	senility, technical, fracture >12 hr previously, irreducible fracture, and nonresidence	index, cancer not reported	71%
Parker, 2002[156], and Parker, 2000[68]	IF (3 screws) vs. uncemented unipolar hemi	United Kingdom	455	71+, fit for surgery, with displaced femoral neck fracture	Rheumatoid or osteoarthritis, chronic renal failure, delay to surgery of >48 hr, pathological fracture	Bilateral, non-index not reported	82, 71-103, 80%
Puolakka, 2001[66]	IF (2 screws) vs. cemented hemi (Thompson)	Finland	32	75+ with displaced femoral neck fracture	Unable to walk independently, rheumatoid arthritis	Bilateral, non-index, cancer not reported	82, 76-90, 84%
van Dortmont, 2000[69]	IF (3 screws) vs. cemented hemi (Thompson)	Netherlands	60	70+ patients with dementia with displaced fracture	None listed	Bilateral, non-index, cancer not reported	84, 71-96, 87%
van Vugt, 1993 [70]	IF (DHS) vs. cemented bipolar hemi	Netherlands	43	71-80 yr, displaced femoral neck fracture, with a good degree of independence	None listed	Bilateral, non-index, cancer not reported	76, SD 3, 58%
Node 1 - Displaced – Internal Fixation vs. Total Hip							
Johansson, 2006[157]	IF (2 screws) vs. total hip arthroplasty	Sweden	146	75+ years displaced femoral neck fractures,	Non-index fracture, contraindications to surgery,	3 patients with bilateral involvement	84, 75-101, 76%

				prefracture walking ability	malignancy, inflammatory arthritis		
Blomfeldt, 2005[74], Tidermark 2003[160,161]	IF (2 screws) vs. THA	Sweden	102	Displaced femoral neck fracture, 70+ years, independent living status, ability to walk independently with or without walking aids	Severe mental cognition dysfunction, pathological fracture, >24 hr before presentation, or rheumatoid or osteoarthritis	Bilateral, non-index, cancer, trauma not reported	80, 70-96, 80%
Johansson, 2000[99], Bachrach-Lindström, 2000[158], and Johansson, 2001[159]	IF (2 screws) vs. THA	Sweden	100	75+, ambulatory prior to displaced femoral neck fracture	No major surgery contraindications, malignancy, rheumatic arthritis (anesthesiologist approval for THA before randomization)	Bilateral, non-index, trauma not reported	84, 75-101, 74%
Jónsson, 1996[73]	IF (2 hook pins) vs. THA	Sweden	47	Living in own home, fully ambulatory prefracture	>48 hr at admission, good candidate for THA	Bilateral, non-index, cancer not reported	80, 67-89, 77%

*SD = standard deviation, IF = internal fixation, THA = total hip arthroplasty, hemi = hemiarthroplasty, NR = not reported, NH = nursing home, CHS = compression hip screw, DHS = dynamic hip screw.

TABLE E-4 Femoral Neck Fracture Randomized Trial Evidence Table, Part 2

Author, Year	Comparison	Patient Outcomes	Assessment *(mo)*	Loss to Follow-up	Important Findings
Node 4 Displaced – Arthroplasty – Hemi Choices					
Emery, 1991[146]	Cemented stem vs. uncemented, bipolar hemi	Mortality, pain, use of walking aids, living arrangements	Mean, 17 or 18 mo (range, 12-27 or 12-30 mo)	26% mortality, no attrition	Less pain and use of walking aids in cemented hemi
Livesley, 1993[147]	Ceramic coated vs. not coated, bipolar hemi	Mortality, complications, residence at 1 year, able to go shopping, functional assessment	12	38% mortality, no attrition	More complications post-surgery in HA-coated hemi. HA used less walking aids, more likely to walk prefracture distance, go shopping, less pain with activity.
Node 4 Displaced – Internal Fixation – Cemented vs. Not Cemented Screws					
Mattsson, 2006[148]	IF - Calcium phosphate vs. no calcium phosphate	Pain, walking aid, activities of daily living, muscle strength, mobility scale, range of motion	6 wk, 6, 12, 24	20% mortality, 21% attrition	Underpowered by 6 mo. 118 enrolled, 24 died, 43 finished 24-mo follow-up. No significant differences found after 6 wk
Mattson, 2003[149]	IF - Calcium phosphate vs. no calcium phosphate	No patient outcomes	1 and 6 wk	None	Cemented screws had better overall stability
Node 3 Displaced –					

Arthroplasty – Uni vs. Bipolar Hemi					
Raia, 2003[51]	Unipolar vs. bipolar hemi (cemented stems)	Musculoskeletal functional assessment: mobility and activities of daily living, SF-36, return to community ambulation	3, 12	21% mortality, 11% attrition	No differences
Cornell, 1998[48]	Unipolar vs. bipolar hemi (cemented stems)	Range of motion, "get up and go", 6-min walk, Johansen hip score	6	None	No differences
Node 3 Inclusive – Internal Fixation – Hook Pins vs. Screws					
Mjørud, 2006[55]	IF - 2 hook pins vs. 3 screws	Walking ability (short term only), mortality, living situation (incomplete data), reoperation	4, 12, 24	31% mortality, no attrition	Both groups showed declined walking ability at 2 yr
Lykke, 2003[56]	IF - 2 hook pins vs. 3 screws	Mortality, discharge to living situation, pain (no data)	4, 12, 24	33% mortality, NR attrition	Results not by fracture type. No differences. Trend to fewer reoperations by experienced surgeon (no data)
Herngren, 1992[57]	IF - 2 hook pins	Mortality,	1, 4, 12	18%	Included raw data, minimal

	vs. 2 screws	reoperations/time to complication, need for walking aid, degree of pain		mortality, 3% attrition	analyses. Did not define "success"; concluded that one year success rate was higher in Uppsala versus hook pin patients
Olerud, 1991[58]	IF - 2 hook pins vs. 2 screws	Mortality, reoperations, pain when walking, pain during passive joint motion	4, 12	19% mortality, no attrition	Less pain and use of walking aids in Uppsala vs. hook pin (complications by fracture type)
Node 3 Inclusive – Internal Fixation – Screws vs. Screws					
Lagerby, 1998[150]	IF - 2 vs. 3 screws	Mortality, reoperations and/or time to complication, need for walking aid, degree of pain	1, 4, 12	20% mortality, unclear attrition, at least 10%	Results given by fracture pattern also. No differences between groups
Rehnberg, 1989[53]	IF - 2 vs. 2 screws	Mortality, pain, need for walking aids, living conditions	4, 12	26% mortality, 23% attrition	Uppsala technique had less pain at both times, less need for walking aids at 4 mo (no data provided—surgeon experience trending related to outcomes)
Node 2 Displaced – Arthroplasty – Hemi vs. THA					
Baker, 2006[63]	Hemi (cemented unipolar) vs. THA	Oxford hip score, walking distance, SF-36	3, 12, 36	10% mortality, 2% attrition	Neither THA nor hemi regained baseline Harris or SF-36; THA had better walking at three years

Blomfeldt, 2007[61]	Hemi (cemented bipolar) vs. THA	ADL, living condition	4, 12	6% mortality, 2% attrition	Harris hip scores (driven by pain, function) higher in total hip arthroplasty at both time periods
Node 2 Displaced – Internal Fixation – Pins/Screws vs. Plate and Screws					
Benterud, 1997[59]	IF - Sliding screw plate plus screw vs. 2 screws	Mortality, reoperations/ complications	Mean of 29 (15-41) or mean of 27 (13-41)	26% mortality, unclear attrition	No patient outcomes. Experienced surgeons perform better surgery
Madsen, 1987[151], and Linde, 1986[152]	IF - Sliding screw plate vs. 4 screws	Living at home, reoperations	3, 36	26% overall loss	No differences. Reported type of surgeon in training (no data) not significant, but operation outside ordinary working time (no data) was significant risk of failure for sliding hip screw
Paus, 1986[54]	IF - Hip compression screw vs. 2 screws	Mortality, rate of union	3, 6, 12, 24	11% mortality, no attrition	Screw vs. plate had higher union rate
Elmerson, 1995[60]	IF - Sliding screw plate vs. 2 hook pin	Mortality, failure rate	6 wk, 3, 6, 12, 24	19% mortality, 4% attrition	No difference. Multivariate analysis (no detail) found displaced fracture, unsatisfactory reduction, unsatisfactory device position, female sex predictive of healing complications
Node 1 Displaced – Internal Fixation vs. Hemi vs. THA					
Skinner, 1989[62], and Ravikumar, 2000[65]	IF vs. hemi vs. THA	Mortality, pain, loss of prefracture	2, 12, follow-up at 13 yr	Mortality: 25% 1 yr, 86% 13	No significant differences between IF and hemi in first year. Hemi had slightly less pain, better mobility,

		mobility, Harris hip		yr; Attrition 1 yr, NR 13 yr	lower Harris hip, less mortality than IF—no p values provided. THA did best
Keating, 2006[64], Keating, 2005[75]	IF vs. hemi vs. THA (various types)	Hip-rating questionnaire, EQ-5D, mortality, reoperation for 60-74 year olds versus ≥ 75 year olds. Unadjusted costs.	4, 12, 24	14% mortality, 6% attrition	Reoperation higher for IF (THA more likely to be by senior surgeon). IF worse hip score at all time points. Difference larger in younger group (<75 yr), largest in walking and function subscores at 24 mo; THA generally better than hemi. EQ-5D bipolar worse than THA at 24 mo
Rogmark, 2002[153], and Rogmark 2003[154]	IF vs. arthroplasty (various types)	Mortality, failure rate, outcome questionnaire	4, 12, 24	21% mortality, no attrition	Mortality not different by group, but men more likely to die. IF had higher failure rate. Women more likely to have IF failure
Node 1 Displaced – Internal Fixation vs. Hemi					
El-Abed, 2005[71]	IF (DHS) vs. uncemented unipolar hemi	Matta function score, SF-36, reoperation, mortality	Min. of 36	22% mortality, NR attrition	Matta score and SF-36 better for IF vs. hemi. Mortality in hemi group higher
Davison, 2001[67]	IF (CHS) vs. hemi, cemented unipolar and bipolar	Mortality, reoperation, return to preinjury state, satisfaction, Harris hip score, Barthel home index	6 wk, 12, 24, 36, 48, 60	23% mortality at 3 yr, overall mortality and attrition 61% at 5 yr	More revisions for IF. Higher mortality for arthroplasty. IF less likely to be satisfied with recovery in first two years; difference was NS by third year
Blomfeldt, 2005[155]	IF (2 screws) vs.	Failure and/or	4, 12, 24	42%	EQ-5D worse for hemi at 24 mo.

	uncemented unipolar hemi	reoperation, mortality, Charnley scores for pain, movement, walking, activities of daily living, EQ-5D, number with hip complications		mortality, 2% attrition	Trends for improved mobility in IF, but trend to more reoperations as well
Rödén, 2003[72]	IF (2 screws) vs. cemented bipolar hemi	Reoperations, mortality, return to prefracture walking, analgesic consumption	4, 12, 24, 60	NR	IF required more reoperations. More hemi patients returned to prefracture walking ability and used less analgesics at 4 mo, but no differences by 5 yr (silent about 1-4 yr)
Parker, 2002[156], and Parker, 2000[68]	IF (3 screws) vs. uncemented unipolar hemi	Mortality, pain, mobility score, same walking aids, return to residential status, (some by phone, some by clinic visit), reoperations	Min. of 12, also 24, 36	Approx. 27% mortality, no attrition	No differences except more reoperations in IF
Puolakka, 2001[66]	IF (2 screws) vs. cemented hemi (Thompson)	Mortality, reoperations	24	47% mortality, NR attrition	Fewer reoperations for hemi

van Dortmont, 2000[69]	IF (3 screws) vs. cemented hemi (Thompson)	Mortality, wound complication	4, 12, 24	57% 1 yr mortality, NR attrition	Reduction was NS to outcomes (low numbers?). High wound complication for hemi disallowed early discharge. Both groups showed dramatic deterioration in ability to walk. Authors suggest treatment to free of pain and allow early discharge is best
van Vugt, 1993[70]	IF (DHS) vs. cemented bipolar hemi	Clinical result score based on secondary intervention, loss of independence, pain, hip mobility score: excellent, good, moderate, poor	3, 6, 12, 24, 36	26% mortality, 2% attrition	Worse clinical result scores at 36 mo for hemi
Node 1 -Displaced – Internal Fixation vs. THA					
Johansson, 2006[157]	IF (2 screws) vs. THA	Mortality, reoperation and/or dislocation, dislocation and mortality by mental impairment, Harris hip score, pain (no data) costs	3, 12, 24	29% mortality, 9% attrition	THA better Harris hip at all periods. Pain prevalence higher for IF. Mentally impaired with IF higher pain at 3 mo, not at 1 yr
Blomfeldt 2005[74], and Tidermark, 2003[160,161]	IF (2 screws) vs. THA	Failure and/or reoperation,	4, 12, 24, 48	25% mortality,	Failure and/or reoperations higher in IF. THA had better Charnley

		mortality, Charnley scores for pain, movement, walking, activities of daily living, EQ-5D, number with hip complications		5% attrition	scores at 4, 12, 24, but not at 48 mo. Both groups had worse walking ability at 48 compared with 24 mo. EQ-5D better for THA at 4 and 12 mo THA less likely to have experienced hip complication
Johansson, 2000[99], Bachrach-Lindström, 2000[158], and Johansson 2001[159]	IF (2 screws) vs. THA	Mortality, reoperation and/or complication, Harris hip score, dependence on help by Katz ADL	3, 12, 24	33% mortality, 9% attrition	Higher mortality and fracture complications for mental dysfunction. Harris hip scores better for THA at 3 and 12 mo, but reaching borderline significance by 24
Jónsson, 1996[73]	IF (2 hook pins) vs. THA	Use of walking aids, able to do own shopping, walking distance, pain, use of analgesics, home assistance for <4 hr/wk	4, 12, 24	2% mortality, 26% attrition	THA more likely to walk without aid at 1 and 2 yr, and more able to do own shopping at 1 yr

*IF = internal fixation, HA = hydroxyapatite, NR = not reported, SF-36 = Short Form-36, THA = total hip arthroplasty, hemi = hemiarthroplasty, ADL = activities of daily living, EQ-5D = Euro-Qol 5D, CHS = compression hip screw, NS = not significant, and DHS = dynamic hip screw.

TABLE E-5 Intertrochanteric and Subtrochanteric Hip Fracture Randomized Trial Evidence Table, Part 1

Author, Year	Comparison	Country	No. Enrolled	Inclusion	Exclusion	Exclusion Problems	Average Age, Range or SD, % Female
Node 3 Plate-with-Screw Comparisons – Inclusive							
Mattsson, 2005[101]	EX - DHS with vs. no calcium phosphate cement	Sweden	112	65+ yr, ambulatory with or without support, with unstable trochanteric fracture, 65+ years, <72 hr between fracture and surgery	Dementia, serious concomitant illness or mental instability, inability to perform functional tests, soft-tissue infection at operation site, cancer, pathological fracture, clotting disorder, corticosteroid treatment >5 mg/day, concurrent or bilateral fracture.		82, SD 7 or 6.3, 81%
Mattsson, 2004[162]	EX - DHS with vs. no calcium phosphate cement	Sweden	26	Unstable IT fracture, walking without aid or with one cane prior to fracture, normal contralateral hip	Senility, pathological fracture, concurrent fractures		83, 66-95, 85%
Node 3 Plate/Screw Comparisons - Unstable							
Moroni, 2004[100]	EX - DHS with	Italy	120	Osteoporosis (by DXA analysis)	Previous hip fracture, open fracture, cancer,		81, SD 8 or 6, 100%

	HA vs. no HA cement			with trochanteric fractures	hard or soft-tissue infection at fracture site, multiple fractures, poor positioning of device according to Baumgartner method		
Sernbo, 1994[163]	EX - CHS with vs. without locking lag screw	Sweden	200	Trochanteric hip fracture	Fractures >5 days old, pathological fractures, subtrochanteric fractures	Bilateral, non-index, trauma not reported	80, NR, 82%
Node 3 Intramedullary Nail Comparison - Inclusive							
Hardy, 2003[104]	IM - IMHS (1 screw) static vs. dynamic locking	Belgium	81	Fractures with loss of the medial buttress (J-M Type IV-V) or reversed oblique fracture	None stated	Bilateral, non-index, cancer not reported	77, SD 11.8 and 13.1, 63%
Node 2 Intramedullary Nail Comparison – Inclusive							
Efstathopoulos, 2007[102]	IM - Gamma 1 screw vs. Ace Nail 2 screw	Greece	112	65+ with Evans-Jensen type I-IV (not specifically stated—determined from	Pathological fractures secondary to metastasis, nonambulatory patients, ASA score	4 (4%) high energy trauma	78, 69-89, 71%

	construct			exclusion criteria)	V, previous ipsilateral or contralateral hip fracture		
Herrera, 2002[164]	IM - Gamma 1 screw vs. PFN 2 screw	Spain	250	Pertrochanteric fractures	None listed	Pathological fractures noted in results	79, NR, 72%
Node 2 Plate/Screw Comparisons –Unstable							
Lunsjö, 2001[80]	EX - Medoff (shaft compression) vs. DHS, DHS+TSP, or DCS (by surgeon)	Sweden	569	Unstable intertrochanteric fracture	Pathological fractures, previous surgery of the proximal part of femur, 2-part fractures	Bilateral not reported	81, 42-99, 67%
Node 2 Plate/Screw Comparisons – Inclusive							
Peyser, 2007[76]	EX - CHS (1 screw) vs. PCCP (2 screw)	Israel	104	60+ with intertrochanteric fracture, amenable to closed reduction	AO/OTA 31.A3, pathological fractures, ipsilateral lower-limb surgery, bilateral hip fracture within last 12 mo Failure at closed		82, 62-95, 67%

					reduction excluded 11 patients. Unavailable participating surgeons excluded another 7 patients		
Kosygan, 2002[78]	EX - CHS (1 screw) vs. PCCP (2 screw)	United Kingdom	111	Extracapsular fracture	Pathological fractures, subtrochanteric fractures or subtrochanteric extension	Bilateral, non-index not reported	83, 53-97, 81%
Janzing, 2002[79] and Brandt, 2002[165]	EX - DHS (2 screws, some with TSP) vs. PCCP	Belgium	115	60+ years with 31 A1 or A2 pertrochanteric fractures	Severe coxarthrosis of ipsilateral hip, multiple injuries, reverse or bifocal fractures	Cancer, non-index not reported	83, 64-98, NR
Olsson, 2001[77]	EX (CHS) vs. Medoff (shaft compression)	Sweden	114	Intertrochanteric fracture of the hip	Earlier surgery of the ipsilateral femur, pathological fractures	Bilateral not reported	84, 61-98, 70%
Watson, 1998[47]	EX (CHS) vs. Medoff (shaft compression)	United States	178	Adults with acute intertrochanteric fracture	Pathological fracture, previous ipsilateral hip fracture or surgery, congenital or developmental anomaly	4 bilateral fractures; trauma not reported	76, 25-99, 66%
Node 2 Intramedullary Nail							

Comparison – Unstable							
Vidyadhara, 2007[103]	IM - Gamma 1 screw vs. Ace Nail 2-screw construct	India	73	60+ years with unstable trochanteric fracture	Inability to walk before injury; other fractures interfering with rehab; pathological fractures	14 (19%) high-energy trauma, bilateral, non-index not reported	69, 61-89, 49%
Schipper, 2004[30]	IM - Gamma 1 screw vs. PFN 2 screw	Netherlands	424	60+ years with unstable trochanteric fracture, walking ability prior to fracture	Pathological fracture, other fractures interfering with rehabilitation		82, SD 8.4 or 8, 82%
Fritz, 1999[81]	IM - Gamma (130°) vs. Gliding Nail (125°)	Germany	80	Unstable intertrochanteric fracture	Intracapsular fractures, pathological fractures, coxarthrosis	At least 3 high-energy trauma. Bilateral, non-index, not reported	82, NR, 86%
Node 1 Plate/Screw vs. Intramedullary Nail – Inclusive							
Hardy, 1998[87]	EX (CHS) vs. IM (IMHS)	Belgium	100	60+ years with an intertrochanteric fracture that allowed fixture by IHMS or CHS	Pathological fracture, previous fracture and/or operation involving the ipsilateral hip, non-index fracture	Bilateral not reported	81, SD 10.7 or 11.8, 77%
Baumgaert	EX (CHS	Unite	131	Intertrochanteric	Pathological fracture	5 high-	79, 40-99, 66%

ner, 1998[46]	plus side plate) vs. IM (IMHS)	d States		fracture		energy trauma, 4 bilateral, non-index not reported	
Utrilla, 2005[82]	EX (CHS) vs. IM (T Gamma)	Spain	210	65+ years with a trochanteric fracture of the femur	Subtrochanteric fractures or subtrochanteric fracture extension, pathological fractures, a previous injury involving the lower limbs, severe concomitant medical condition ASA grade V		80, 65-104, 69%
Adams, 2001[93]	EX (CHS) vs. IM (Gamma - 2nd)	Unite d Kingd om	400	Intertrochanteric fracture of the hip	Too frail for operation, residence outside hospital region	2% from high-energy trauma	81, 32-102, 78%
Park, 1998[166]	EX (CHS) vs. IM (Gamma AP)	Korea	60	Intertrochanteric fractures	None listed	Bilateral, non-index, cancer, trauma not reported	73, NR, 60%
Hoffman, 1996[88]	EX (CHS) vs. IM (Gamma)	New Zeala nd	67	50+ years with intertrochanteric fracture	Pathological fracture	Bilateral, non-index, trauma not reported	81, SD 10.4, 76%
Goldhagen , 1994[49]	EX (CHS) vs. IM (Gamma -	Unite d States	75	Peritrochanteric fractures	Ipsilateral fracture or surgery of hip, congenital or developmental	Trauma and 1 pathological fracture.	78, 28-91, 69%

	2nd)				anomaly, fracture pattern not amenable to treatment by two methods	Non-index not reported	
Aune, 1994[167]	EX (CHS) vs. IM (Gamma AP)	Norway	378	Trochanteric and subtrochanteric fractures	None listed	Bilateral, non-index, cancer, trauma not reported	81, 45-96, 59%
Ahrengart, 2002[86]	EX (CHS) vs. IM (Gamma)	Sweden and Finland	492	Intertrochanteric fracture	Subtrochanteric fracture, pathological fracture, previous fracture or operation on same hip, or surgeon unfamiliar with Gamma nail	Bilateral not reported	80, 32-99, 72%
Butt, 1995[89]	EX (DHS) vs. IM (Gamma)	United Kingdom	95	Peritrochanteric fractures	Not listed	Bilateral, non-index, cancer, trauma not reported	78, 47-101, 69%
O'Brien, 1995[83]	EX (DHS) vs. IM (Gamma)	Canada	101	Intertrochanteric hip fractures	Fractures >1 wk old, pathological fractures, subtrochanteric fractures	1 not due to fall. 1 bilateral in Gamma group. Non-index not reported	77, 39-95, 74%
Pajarinen, 2005[84]	EX (DHS) vs. IM (PFN)	Finland	108	Low-energy extracapsular fracture	Pathological fracture, multiple injuries		81, SD 9.9, 75%
Saudan, 2002[92]	EX (DHS) vs. IM (PFN)	Switzerland	206	55+ years, all AO/OTA Type 31-A1 or A2	Pathological fracture, fractures associated with polytrauma,	Bilateral not reported	83, SD 10, 78%

				fractures caused by a low-energy injury	previous ipsilateral hip or femoral surgery, any fracture with extension 5 cm distal to the inferior border of the lesser trochanter		
Radford, 1993[85]	EX (DHS) vs. IM (Gamma)	England	200	60+ years with pertrochanteric fractures	None listed	Bilateral, non-index, cancer, trauma not reported	81, 60-97, 78%
Leung, 1992[90]	EX (DHS) vs. IM (Gamma)	Hong Kong	225	65+ with pertrochanteric fractures	Purely subtrochanteric fractures	1 bilateral. non-index, cancer, trauma not reported	80, SD 9.46, 71%
Bridle, 1991[91]	EX (DHS) vs. IM (Gamma)	England	100	60+ with intertrochnteric fracture	None listed	Bilateral, non-index, cancer, trauma not reported	82, NR, 84%
Node 1 Plate/Screw vs. Intramedullary Nail – Unstable							
Ekström, 2007[94]	EX (Medoff) vs. IM (PFN)	Sweden	203	Adult patients with a closed growth plate and an unstable trochanteric or subtrochanteric	Two-part fracture, high-energy trauma, pathological fracture, previous surgery of the proximal part of femur, an intake of	Bilateral not reported	82, 48-97, 76%

				fracture	daily steroid of >10 mg of prednisolone, ongoing chemotherapy or irradiation treatment due to malignancy, and presence of degenerative osteoarthrosis and/or arthritis in the injured hip		
Miedel, 2005[96]	EX (Medoff) vs. IM (Gamma)	Sweden	217	Acute, unstable trochanteric or subtrochanteric fracture from a simple fall	Pathological fractures, rheumatoid or osteoarthritis, fractures extending >5 cm below lesser trochanter		84, SE 0.6, 81%
Papasimos, 2005[168]	EX (DHS) vs. IM (T Gamma, PFN)	Greece	141	60+ years with extracapsular hip fractures	Prefracture inability to walk, pathological fracture, previous surgery on ipsilateral hip or femur, stable trochanteric fractures AO Type 31-A1, fractures with extension 5 cm distal to inferior border of lesser trochanter	13 (11%) high-energy trauma, bilateral not reported	81, NR, 61%
Pajarinen, 2004[169]	EX (DHS) vs. IM (PFN)	Finland	56	Unstable, low-energy pertrochanteric femoral fractures	Pathological fracture, patients with polytrauma, stable fractures (class A1) and subtrochanteric fractures (class A3)		79, 49-94, 80%

Sadowski, 2002[97]	EX (DCS) vs. IM (PFN)	Switzerland	39	55+ years, 31-A3 fractures from low-energy injury	Pathological fractures, fractures from with polytrauma, a preexisting femoral deformity preventing hip screw osteosynthesis or intramedullary nailing, previous surgery on the ipsilateral hip or femur, and fractures extending 5 cm distal to the inferior border of the lesser trochanter		79, SD 14, 69%
Harrington, 2002[95]	EX (CHS) vs. IM (IMHS)	United Kingdom	102	65+ years with unstable intertrochanteric fracture	Dementia and incapable of providing informed consent, pathological fractures, concomitant fractures, previous proximal femoral fracture	Bilateral not reported	83, SD 8.5, 80%
Node 1 Internal Fixation vs. Hemi – Unstable							
Stappaerts, 1995[170]	IF (CHS) vs. Endopros	Belgium	90	70+ years with unstable peritrochanteric	Non-index, arthritis, fractures with subtrochanteric	Bilateral, cancer, trauma not	83, 70-102 81%

	thesis			fracture	components	reported	
Kim, 2005[98]	IF (PFN) vs. uncemented calcar-replacement bipolar hemi	South Korea	58	75+ unstable comminuted intertrochanteric fracture from low-energy injury	AO/OTA type 31-A1 or A3 fracture	Bilateral, non-index, cancer not reported	82, SD 3.3, 76%
Subtrochanteric Fractures							
Lunsjö, 1999[171]	EX - Medoff (shaft compression) vs. DHS, DHS+TSP, or DCS (by surgeon)	Sweden	107	Subtrochanteric fracture	Pathological fracture, previous surgery of proximal part of femur, factures extending >5 cm distal	Bilateral not reported, one patient (21 yr) not elderly	80, 21-99, 80%

*EX = extramedullary, DHS =dynamic hip screw , SD = standard deviation, HA = hydroxyapatite, DXA = dual x-ray absorptiometry, CHS = compression hip screw, NR = not reported, IM = intramedullary, IMHS = intramedullary hip screw, J-M = Jensen-Michaelson classification, TSP = trochanter stabilizing plate, DCS = dynamic condylar screw, PCCP = percutaneous compression plate, AO/OTA = Arbeitsgemeinschaft für Osteosynthesefragen/Orthopaedic Trauma Association, PFN = proximal femoral nail, hemi = hemiarthroplasty, and ASA = American Society of Anesthesiologists.

TABLE E-6 Intertrochanteric and Subtrochanteric Hip Fracture Randomized Trial Evidence Table, Part 2

Author, Year	Comparison	Subtrochanter	Classification	Patient Outcomes	Assessments *(mo)*	Loss to Follow-up	Important Findings
Node 3 Plate-and-Screw Comparisons – Inclusive							
Mattsson, 2005[101]	EX - DHS with vs. no calcium phosphate cement	NR	E/JM 4-5; AO 31 A1, A2	Pain, SF-36, activities of daily living, strength, walking aids	1 and 6 wk, 6	4% mortality, 13% attrition	Lower pain, better activities of daily living scores, and SF-36 at 6 wk for augmented group; only SF-36 remained significant at 6 mo
Mattsson, 2004[162]	EX - DHS with vs. no calcium phosphate cement	NR	AO 31 A2	No patient outcomes	1 and 6 wk, 6	NR	(Cemented group had less fracture movement during healing. All patients showed less rotation around longitudinal and transversal axes than expected)
Node 3 Plate-and-Screw Comparisons – Unstable							
Moroni,	EX - DHS with	NR	AO A1, A2	Harris hip	6	Replaced	Augmented

2004[100]	HA vs. no HA cement			score, SF-36		patients lost to follow-up	group had higher Harris hip score. Authors suggest cement only for lag screws
Sernbo, 1994[163]	EX - CHS with vs. without locking lag screw	Excluded	Jensen; Hunter and Krajbick	No patient outcomes	4	NR	(More lag screw sliding in group with key and compressing screw, mainly women 80+ with unstable fractures. More in women with previous fractures)
Node 3 Intramedullary Nail Comparison – Inclusive							
Hardy, 2003[104]	IM - IMHS (1 screw) static vs. dynamic locking	NR	E/JM 4-5, reverse oblique	Mortality, mobility score, pain	1, 3, 6, 12+	20% mortality, no attrition	No differences between groups (use of two locking screws correlated with cortical hypertrophy)
Node 2 Plate/Screw Comparisons –							

Inclusive							
Peyser, 2007[76]	EX - CHS (1 screw) vs. PCCP (2 screw)	NR	AO A1, A2	Pain, weight-bearing index, mortality	6 wk, 3, 6, 12	NR	Mortality trending higher for CHS. CHS had higher pain and less weight-bearing ability at 6 wk; no difference by 3 mo
Kosygan, 2002[78]	EX - CHS (1 screw) vs. PCCP (2 screw)	Excluded	E/JM 1-5	Mortality, complications	6 wk, 3, 6	15% mortality, no attrition	Non-device complications higher in CHS
Janzing, 2002[79] and Brandt, 2002[165]	EX - DHS (2 screws, some with TSP) vs. PCCP	NR	AO A1, A2	Mortality, postop. pain, use of walking aids, living situation	1 wk, 3, 6, 12	20% mortality, 8% attrition	No differences between groups except lower pain at 1 week for PCCP
Olsson, 2001[77]	EX (CHS) vs. Medoff (shaft compression)	NR	Jensen 1-5	Mortality, complications, residential status, need for walking support	4	14% mortality, 7% attrition	No differences between groups.
Watson, 1998[47]	EX (CHS) vs. Medoff (shaft compression)	NR	E/JM 1-5 and reverse oblique	(Results by stable/unstable.) Ambulation, living situation, pain,	1 and 6 wk, 3, 6, 12	10% mortality, 7% attrition	(No data provided.) No differences. (All fixation failures in unstable fractures.

				mortality, time to union			Medoff had fewer failures)
Node 2 Plate-and-Screw Comparisons – Unstable							
Lunsjö, 2001[80]	EX - Medoff (shaft compression) vs. DHS, DHS+TSP, or DCS (by surgeon)	NR	E/JM 3-5	Mortality, revision, fixation failure, residential situation, walking ability	4, 12	23% mortality, 8% attrition	All failures were in 4-part fractures. Medoff quicker to bear weight, but no difference in groups at 12 mo in walking ability or living in own home
Node 2 Intramedullary Nail Comparison – Inclusive							
Efstathopoulos 2007[102]	IM - Gamma 1 screw vs. Ace nail 2 screw construct	NR	E/JM 1-4	Mortality, mobility (also by stable/not stable)	1, 3, 6	17% mortality, 4% attrition	No differences
Herrera, 2002[164]	IM - Gamma 1 screw vs. PFN 2 screw	NR	AO A1, A2, A3	No patient outcomes	1, 3, 6, 12	Unclear	Authors recommend PFN over Gamma
Node 2 Intramedullary							

Nail Comparison – Unstable							
Vidyadhara, 2007[103]	IM - Gamma 1 screw vs. Ace nail 2 screw construct	NR	AO A2, A3	Harris hip score, pain, limp	1, 4, 12, 24	None reported	No differences
Schipper, 2004[30]	IM - Gamma 1 screw vs. PFN 2 screw	NR	AO 31 A2, A3	Harris hip score, mortality, reoperations, complications	1, 4, 12	21% mortality, 5% attrition	No differences between groups
Fritz, 1999[81]	IM - Gamma (130°) vs. Gliding nail (125°)	NR	AO A2, A3,	Mortality, complications, living situation, Merle d'Aubigné subscale scores	6	13% mortality, 2% attrition	Mortality trending higher for gliding nail
Node 1 Plate/Screw vs. Intramedullary Nail – Inclusive							
Hardy, 1998[87]	EX (CHS) vs. IM (IMHS)	NR	E/JM 1-5	Mortality, mobility score, pain, social functioning (some by type of fracture)	1, 3, 6, 12	30% mortality, NR attrition	Mobility was better for IMHS at 1 and 3 mo. At 1 yr, more pain in thigh (more likely with two distal locking screws)

							for IMHS. Both mobility and no. of distal locking screws also highly associated with cortical hypertrophy. Better mobility for IMHS used for unstable fractures at all time periods
Baumgaertner, 1998[46]	EX (CHS plus side plate) vs. IM (IMHS)	NR	Evans/Kyle types I - IV	Mortality, return to prefracture living situation, return to prefracture mobility, pain (no group data provided)	6 wk, 3, 6, 12, 24	22% mortality, 0% attrition	No differences
Utrilla, 2005[82]	EX (CHS) vs. IM (T Gamma)	Excluded	E/JM 1-5	Pain, range of hip flexion, walking ability score, mortality, complications	1, 3, 6, 12	19% mortality, 3% attrition	(Short-term follow-up data not provided.) Walking ability for IM for unstable fractures better at 12 mo. (With Bonferroni correction

							would be nonsignificant)
Adams, 2001[93]	EX (CHS) vs. IM (Gamma - 2nd)	NR	AO A1, A2, A3, B2; E/JM 1-5	Harris hip score (global), mortality, living in own home, walking independently (1 stick), reoperations, complications	3, 6, 12	30% mortality, 8% attrition	No difference between groups. (Regression showed Gamma worse if higher TAD)
Park, 1998[166]	EX (CHS) vs. IM (Gamma AP)	NR	Tronzo II, III, IV	Time to union, complications, mobility	3	NR	Time to union for unstable fractures with CHS was longer
Hoffman, 1996[88]	EX (CHS) vs. IM (Gamma)	NR	E/JM 1-5	Mobility, mortality, time to union, pain	6 wk, 3, 6	19% mortality, NR attrition	(No data provided for mobility.) Mobility better for Gamma at 6 wk and 3 mo, not by 6 mo
Goldhagen, 1994[49]	EX (CHS) vs. IM (Gamma - 2nd)	Yes	Kyle; Seinsheimer	Ambulatory status, range of motion, pain, return to preinjury functional level	6	4% mortality, 0% attrition	No difference. (Data only for ambulatory status)

Aune, 1994[167]	EX (CHS) vs. IM (Gamma AP)	Yes	Jensen; Zickel	Reoperation	Median, 17	NR	Gamma needed more reoperations
Ahrengart, 2002[86]	EX (CHS) vs. IM (Gamma)	Excluded	E/JM 1-5	Pain, use of walking aid, lived at home (no outcome descriptions)	6	Unclear	Pain at top of greater trochanter higher in Gamma group
Butt, 1995[89]	EX (DHS) vs. IM (Gamma)	Yes	AO (not provided)	No patient outcomes, time to union, complications	Followed until radiographic union	7% mortality, NR attrition	More femoral shaft fractures in Gamma nail
O'Brien, 1995[83]	EX (DHS) vs. IM (Gamma)	Excluded	Evans	No patient outcomes	12	7% mortality, NR attrition	(Authors did not find Gamma superior in surgery time, blood loss, or complications)
Pajarinen, 2005[84]	EX (DHS) vs. IM (PFN)	NR	AO 31 A1, A2, and "other"	Living situation, recovery to prefracture level, walking ability, recover walking to prefracture level,	6 wk, 4	6% mortality, 14% attrition	At 4 mo, recovery of walking ability better for PFN (would lose to Bonferroni correction)

				mortality			
Saudan, 2002[92]	EX (DHS) vs. IM (PFN)	Excluded	AO 31 A1, A2	Mortality, complications, reoperations, living situation, pain, social function, mobility score, consolidation	3, 6, 12	14% mortality, 4% attrition	No differences between groups (1-yr data only)
Radford, 1993[85]	EX (DHS) vs. IM (Gamma)	NR	Evans	No patient outcomes	3, 12	NR	No differences between groups other than Gamma had more femoral shaft fractures
Leung, 1992[90]	EX (DHS) vs. IM (Gamma)	Excluded (subtrochanteric extension included)	E/JM 1-5	Mean time to full weight-bearing, mobility, hip range of motion, pain in hip or thigh	6-12	12% mortality, 7% attrition	Time to full weight-bearing faster in Gamma nail for both stable and unstable
Bridle, 1991[91]	EX (DHS) vs. IM (Gamma)	NR	Evans	Mobility, mortality, pain, living situation	6	34% mortality, NR attrition	Only data on mortality—no differences
Node 1 Plate-and-Screw vs.							

Intramedullary Nail – Unstable							
Ekström, 2007[94]	EX (Medoff) vs. IM (PFN)	Yes	E/JM 3-5; Seinsheimer 1-5; AO 31 A2, A3, 32 A1, B1	Mortality, mobility, pain, isometric abductor strength, living situation, union, complications (by intertroch./subtroch. type)	6 wk, 4, 12	16% mortality, 25% attrition	Better walking ability at 6 wk for IM nail, no difference by 4 mo
Miedel, 2005[96]	EX (Medoff) vs. IM (Gamma)	Yes	E/JM 3-5, Subtrochanteric S2B-C, S3A-B, S4, S5	(Some results by type of troch./subtroch.) Mortality, revisions, activities of daily living, EQ-5D, Charnley	4, 12	25% mortality, 10% attrition	No differences between groups
Papasimos, 2005[168]	EX (DHS) vs. IM (T Gamma, PFN)	Excluded	AO 31 A2, A3	Salvati and Wilson hip score, (return to prefracture ambulation level and	12	7% mortality, 8% attrition	No differences (Gamma nail highest hip score—no significant test)

				independence—no data), union			
Pajarinen, 2004[169]	EX (DHS) vs. IM (PFN)	Excluded	AO 31A, A2	No patient outcomes	6 wk, 4	4% mortality, 11% attrition	(Both groups had significant changes in hip measures at 6 wk. At 4 mo, difference between groups significant favoring PFN, but clinical significance was unknown)
Sadowski, 2002[97]	EX (DCS) vs. IM (PFN)	Yes	AO 31 A3	Mortality, complications, reoperations, hip and/or thigh pain, social function, mobility score, residence	3, 6, 12	8% mortality, 3% attrition	Complications and reoperations higher for DCS (1-yr data only)
Harrington, 2002[95]	EX (CHS) vs. IM (IMHS)	NR	E/JM 3-5	Ambulation, return to prefracture living situation	3, 5, 12	25% mortality, NR attrition	No differences (no data provided). (Only 1-yr follow-up)
Node 1 Internal Fixation vs. Hemi -							

Unstable							
Stappaerts, 1995[170]	IF (CHS) vs. endoprosthesis	Excluded	AO A2; Evans/Jensen 1C-1D	Short-term walking	3	17% mortality, NR attrition	No differences
Kim, 2005[98]	IF (PFN) vs. uncemented calcar-replacement bipolar hemi	NR	AO A2; E/JM 3 - 4	Harris hip score, activities of daily living, Mini-mental status, ASA, mortality, reoperations / and/or complications	6 wk, 3, 6, 12; avg. 35	36% mortality, no attrition	Overall mortality for hemi greater than IM, seen within the 1 to 3-yr follow-up
Subtrochanteric Fractures							
Lunsjö, 1999[171]	EX - Medoff (shaft compression) vs. DHS, DHS+TSP, or DCS (by surgeon)	Yes	Seinsheimer 1-5;	Mortality, failure, walking aids, living situation	4, 12	15% mortality, 9% attrition	All failures were in combined intertroch./subtroch. fractures. Medoff had lower fixation failure. Medoff quicker to weight-bear, but no difference in groups at 12 mo in walking ability or living in own home

*IF = internal fixation, EX = extramedullary, HA = hydroxyapatite, DHS = dynamic hip screw, IT = intertrochanteric , DXA = dual x-ray absorptiometry, NR = not reported, IM = intramedullary, IMHS = intramedullary hip screw , J-M = Jensen-Michaelson classification, TSP = trochanter stabilizing plate, DCS = dynamic condylar screw, PCCP = percutaneous compression plate, PFN = proximal femoral nail, ASA = American Society of Anesthesiologists, E/J = Evans-Jensen classification, E/JM = Evans classification as modified by Jensen and Michaelson, CHS = compression hip screw, MSP = Medoff sliding plate, TAD = tip-apex distance, and EQ-5D = Euro-Qol.

TABLE E-7 Observational Studies of Hip Fracture Outcomes

Author, Year, Country	Study Aim	No. of Patients	Mean Follow-up	Patient Group	Fracture Type	Surgical Treatment	Site	Reported Results
Focused Research Question								
Karagiannis, 2006[108], Greece	Examine relationship among patient factors, fracture type, and long-term mortality	499	10 yr	60+ yr, excluded subtrochanteric, pathological, non-index, and high-energy trauma fractures	FN, IT, no subtypes	None reported	Single hospital site	Age, sex, type of fracture, heart failure were independent predictors of 10-yr mortality. IT had 1.37× higher probability of mortality. Did not adjust for functional or cognitive status
Cornwall, 2004[107], U.S.	Examine relationship among fracture type, patient characteristics, and mortality and functional outcomes	804	6 mo	50+ yr, excluding bilateral, pathological, multiple trauma, non-index	FN – displaced and not displaced; IT – stable and unstable	Yes, 100% correlated with type of fracture, IT and hemi	4 New York hospitals	Nondisplaced fractures more likely in younger patients. Preinjury functional dependence predicted mortality. Age, sex, fracture type, comorbidities, perioperative factors were not predictive. Age and preinjury functional dependence predicted functional outcomes
Fox, 1999[134], U.S.	Examine relationship among fracture type, patient	923	12 mo	65+ yr, community dwelling, ambulatory.	FN, IT, no subtypes	Internal fixation, hemi, THA	7 hospital sites	IT had lower recovery at 2 mo, and higher mortality at 2 and 6 mo. No differences between fracture types remained

	characteristics, and mortality and functional outcomes							at 12 mo. Surgical treatment did not affect the model when added
Generalized Research Question – Fracture type included in multivariate analysis								
Heikkinen, 2004[105], Finland	Examine predictors of mortality and function after hip fracture	2279	4 mo	50+ yr	Displaced/ undisplaced FN, IT 2 or multiple fragment, subtrochanter	Multiple internal fixation, hemi, THA	6 hospital sites	Prefracture residence, mobility, morbidity, and age were predictive of 4-mo mortality and function. Fracture type and surgical method were not predictive. Differences in hospital preferences for surgical treatment found. Potential effects of possible multicollinearity between variables not discussed
Hannan, 2001[106], U.S.	Examine patient factors for risk factors for 6-mo mortality and functional status for hip	571	6 mo	50+ yr, no concurrent major injuries, pathological fractures, fractures, isolated pelvic or	Displaced and nondisplaced FN, IT without subtypes	Treatment 100% correlated with fracture type: IF, hemi	4 hospital sites. Outcomes adjusted by site.	Age, prefracture mobility, and nursing-home residence predicted mobility. APACHE score, low prefracture mobility, and paid help at home were predictive of

	fracture patients,			acetabular fractures, bilateral fractures, non-index fractures				mortality. When the two outcomes were combined as adverse outcomes, dementia was also predictive. Fracture type was not a significant predictor
Koval, 1998[8], U.S.	Examine predictors of activities of daily living/IADLs after hip fracture	338	12 mo	65+ yr, community dwelling, ambulatory, cognitively intact with nonpathological fractures	FN, IT, no subtypes	None reported	Single hospital site	Age and prefracture activities of daily living/IADLs predicted recovery at 3 and 6 mo. Patient age was the only independent predictor at 1 yr. Fracture type was not a predictor
Koval, 1996[111], U.S.	Examine predictors of dependency after hip fracture	431	12 mo	65+ yr, community dwelling, ambulatory, cognitively intact with nonpathological fractures	FN, IT, no subtypes	None reported	Single hospital site	Age, prefracture independence in activities of daily living/IADLs, no. of comorbidities were predictive at 3, 6, and 12 mo of patient regaining prefracture independence. Fracture type was not significant
Koval, 1995[9], U.S.	Examine predictors of ambulatory ability after hip fracture	336	12-18 mo	65+ yr, community dwelling, ambulatory, cognitively intact with nonpathological fractures	FN, IT, no subtypes	Treatment 100% correlated with fracture type: IF, hemi	Single hospital site	Fracture type not predictive of a decline in ambulatory status for all patients or previous community ambulators. However, IT was borderline predictive of a patient becoming household or

								nonfunctional ambulator. Age, prefracture mobility, ASA rating were also predictors.
Borgquist, 1991[112], Sweden	Examine predictors of independent activities of daily living after hip fracture in the elderly	827	4 mo	50+ yr, community dwelling prior to fracture	FN, IT, no subtypes	Yes, treatment reported 100% correlated with fracture type	Single hospital site	Age, sex, and living with someone predicted living at home at 4 mo. Type of fracture, prefracture mobility, and activities of daily livings were not predictive. Age, FN fracture, gender predicted independent activities of daily livings at 4 mo

*FN = femoral neck, IT = intertrochanteric, THA = total hip arthroplasty, hemi = hemiarthroplasty, IADL = independence in activities of daily living, ASA = American Society of Anesthesiologists, and APACHE = Acute Physiology and Chronic Health Evaluation II score.

TABLE E-8 Number of Randomized Studies Reporting Post-Treatment Outcomes by Comparison Groups

Comparison	Pain (Categorical)	Pain (Continuous)	Function (Categorical)	Function (Continuous)
Femoral neck fractures				
Arthroplasty: various hemiarthroplasty vs. hemiarthroplasty	1	0	2	0
Internal fixation: cemented vs. not cemented	0	0	0	0
Arthroplasty: unipolar vs. bipolar hemiarthroplasty	0	0	1	1
Internal fixation: hook pins vs. screws	1	0	0	0
Internal fixation: various screws vs. screws	1	1	2	1
Arthroplasty: hemiarthroplasty vs. total hip arthroplasty	0	2	1	4
Internal fixation: pins and screws vs. plate and screws	0	0	0	0
Internal fixation vs. hemiarthroplasty	2	1	5	2
Internal fixation vs. total hip arthroplasty	1	1	1	1
Internal fixation vs. arthroplasty	1	0	1	0
Intertrochanteric fractures				
Plate and screw comparisons	0	0	0	0
Intramedullary nail comparisons	1	0	0	0
Plate and screw comparisons	0	2	3	2
Intramedullary nail comparisons	0	1	2	3
Plate and screw vs. intramedullary nail	6	2	9	4
Subtrochanteric fractures				
Plate and screw vs. Intramedullary nail	0	0	1	0