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# Nail or Plate Fixation of Intertrochanteric Hip Fractures: Changing Pattern of Practice

## A Review of the American Board of Orthopaedic Surgery Database

By Jeffrey O. Anglen, MD, and James N. Weinstein, DO, on Behalf of the American Board of Orthopaedic Surgery Research Committee

**Background:** A new method of fixation for intertrochanteric hip fractures that involves the use of an intramedullary nail that interlocks proximally into the femoral head was introduced in the early 1990s. Anecdotal observation of practice patterns during the Part II (oral) American Board of Orthopaedic Surgery examination suggested that the use of this method had increased substantially in recent years in comparison with the more traditional sliding compression screw technique. A study of the Part II database was undertaken to detect changing patterns of care for intertrochanteric fractures.

**Methods:** During the process of Board certification, candidates for the Part II (oral) examination submit a six-month surgical case list and patient data into a secure database. The database was searched for all intertrochanteric fractures (International Classification of Diseases, Ninth Revision, code 820.20 or 820.21) over a seven-year period (1999 through 2006). The cases were categorized by intramedullary nail or plate fixation on the basis of surgeon-reported Current Procedural Terminology codes. Relative utilization of the two devices was analyzed according to year and region, and the devices were compared in terms of complications and outcomes.

**Results:** A dramatic change in practice was demonstrated, with the intramedullary nail fixation rate increasing from 3% in 1999 to 67% in 2006. Regional variation was substantial. The highest rate of utilization of intramedullary nail fixation was recorded by candidates from the South, Southeast, and Southwest, who converted to the new technology faster than those in the Northeast, Northwest, and Midwest. Overall, patients managed with plate fixation had slightly less pain and deformity in comparison with those managed with intramedullary nailing, with no significant differences being identified in terms of function or satisfaction. Patients managed with intramedullary nailing had more procedure-related complications, particularly bone fracture.

**Conclusions:** From 1999 to 2006, a dramatic change in surgeon preference for the fixation device used for the treatment of intertrochanteric fractures has occurred among young orthopaedic surgeons. This change has occurred despite a lack of evidence in the literature supporting the change and in the face of the potential for more complications.

Over the past fifty years, a wide variety of implants and fixation strategies have been utilized for the surgical stabilization of intertrochanteric hip fractures. The introduction of the sliding compression hip screw and side plate in the 1950s was considered a major advance over previous nail-plate devices<sup>1,2</sup>. The use of the sliding compression hip screw and side plate became the standard of care for the surgical treatment of these fractures, although other methods continued to be available.

In the early 1990s, a new fixation device was introduced for the treatment of intertrochanteric fractures. This device

consisted of a short intramedullary nail that was placed through the greater trochanter, with a large-diameter proximal interlocking screw that was inserted in a retrograde fashion up the femoral neck. The earliest version of this device was the Gamma nail (introduced by Howmedica, now Stryker, Kalamazoo, Michigan). The proposed advantages were insertion through a so-called minimally invasive incision and improved fracture fixation biomechanics<sup>3,4</sup>. In the years since the introduction of the Gamma nail, several similar intramedullary fixation devices of different design have been introduced by other companies.

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**TABLE I Complications Data Collected in the ABOS Part II Database\***

Medical Complications	Surgical Complications	Procedure-Related Complication Subgroup	Wound-Related Complication Subgroup	Implant Complication Subgroup	Union Subgroup
Anesthetic	Hemorrhage	Hemorrhage	Hemorrhage	Implant failure	Delayed union
Cerebrovascular accident	Bone fracture	Infection	Infection	Implant fracture	Nonunion
Congestive heart failure	Implant failure	Wound dehiscence	Dehiscence		
Myocardial infarction	Implant fracture	Bone fracture			
Pneumonia	Infection	Implant failure/fracture			
Pulmonary embolism	Limb ischemia	Nonunion/delayed union			
Renal failure	Wound dehiscence	Surgical procedure intervention			
Patient expires	Nerve palsy/injury	Surgical unspecified			
Medical unspecified	Delayed/nonunion Skin ulcer/blister Tendon ligament injury Surgical procedure intervention Surgical unspecified (begun in 2004)				

\*ABOS = American Board of Orthopaedic Surgery.

During the administration of Part II (oral) examinations for the American Board of Orthopaedic Surgery over the past few years, we observed that orthopaedic surgeons seemed to be fixing intertrochanteric fractures preferentially with intramedullary nails rather than sliding compression hip screws. The different Current Procedural Terminology (CPT) codes for the two fixation options allow quantification of this phenomenon with use of the Part II database.

Our hypothesis was that examination of the Part II case lists would reveal a significant change in utilization of the two types of fixation implant for intertrochanteric fracture over the years studied.

### Materials and Methods

Board certification in orthopaedic surgery is a two-part process consisting of a written examination (Part I) and a practice-based oral examination (Part II). Candidates are eligible to take Part I upon completion of an accredited residency. To sit for Part II, they must successfully pass Part I and then practice for twenty-two months. Seventy percent of candidates take the Part II (oral) examination of the American Board of Orthopaedic Surgery within the first two years after completion of their training (residency or fellowship), and 98% take the Part II examination within the first five years.

During the process of Part II, candidates submit lists of all surgical procedures that they performed during a defined six-month period. Case lists are certified and notarized by

medical records custodians at each institution. All operative cases from all hospitals and surgery centers must be reported, even for patients who have no available postoperative follow-up. Since 1999, defined specific data from each of the cases have been entered into a secure online database maintained by the American Board of Orthopaedic Surgery. This occurs one to six months after surgery, and no long-term outcomes or patient-derived data are collected. The information that is collected includes the date of the procedure, the location of the candi-

**TABLE II Comparison of Plate Fixation to Nail Fixation for Intertrochanteric Fractures Each Year, 1999 through 2006**

Examination Year	Plate	Nail
1999	2008 (97%)	60 (3%)
2000	2372 (94%)	155 (6%)
2001	2173 (86%)	352 (14%)
2002	1932 (84%)	374 (16%)
2003	1519 (73%)	551 (27%)
2004	1403 (61%)	890 (39%)
2005	1197 (47%)	1330 (53%)
2006	785 (33%)	1619 (67%)
Total	13,389	5331

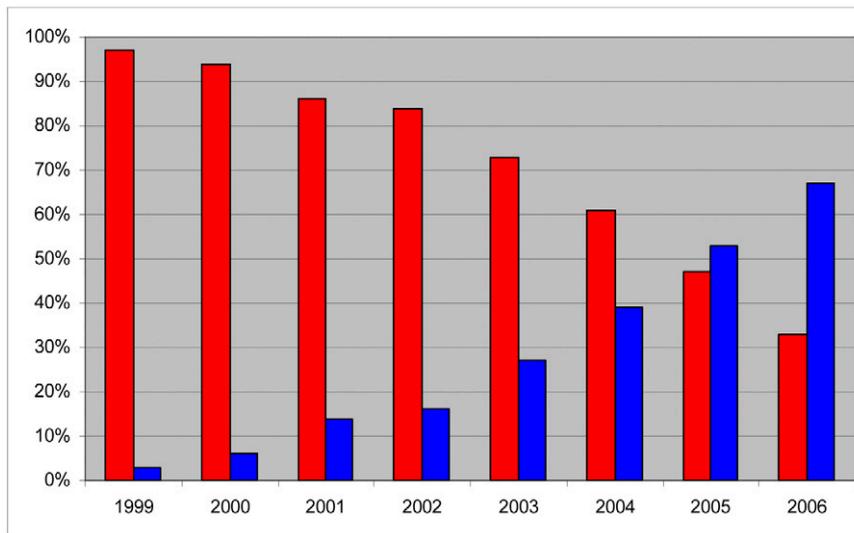


Fig. 1  
Bar graph illustrating the proportion of intertrochanteric fractures fixed with plates (red bars) compared with nails (blue bars).

date's practice, ICD-9 (International Classification of Diseases, Ninth Revision) diagnosis codes, CPT codes, patient age and gender, surgical and medical complications, and four candidate-reported outcome measures (pain, deformity, function, and patient satisfaction).

These outcomes are purposefully generic because they are meant to apply to the full spectrum of orthopaedic procedures and to give a general sense of the success or failure of a procedure for use by the oral examiners of the American Board of Orthopaedic Surgery. The outcome measures and response categories are pain (increased, unchanged, decreased, and absent), deformity (increased, unchanged, improved, and normal), function (decreased, unchanged, improved, and normal), and patient satisfaction (poor, fair, good, and excellent). The scales are provided to candidates by means of drop-down menus during the online submission of case data. They are provided without specific definitions. Each candidate is allowed to enter these outcomes on the basis of his or her own subjective assessment of the patient. The follow-up period for the patients when the data are entered varies from a few weeks to a few months. In order to average and compare outcomes, we assigned an integral value of 1 to 4 to each of the possible outcome categories on each scale, with 1 being the worst outcome and 4 being the best. For example, on the pain scale, "increased" is 1, "unchanged" is 2, "decreased" is 3, and "absent" is 4.

Complications are similarly entered from drop-down menu lists of medical and surgical complications. The list of complications is displayed in Table I. The category of "surgical unspecified" was added to the complication list in 2004 to allow for the designation of rare adverse events that may be associated with a specific surgical procedure. Complications were grouped into subgroups for analysis. One subgroup was designated "procedure-related complications" and included

hemorrhage, wound infection, wound dehiscence, bone fracture, implant failure or fracture, delayed union or nonunion, surgical procedure intervention (unplanned return to the operating room), and surgical unspecified.

The American Board of Orthopaedic Surgery Part II database was searched for all intertrochanteric fractures (ICD-9 codes 820.20 and 820.21) from the years 1999 through 2006. These fractures were separated into two groups on the basis of CPT codes for plate and screw fixation (27244) or intramedullary fixation (27245), and the relative proportions of the two procedures were compared for each year. The states were separated into six arbitrary regions for geographic analysis, loosely based on the ten trauma regions of the American College of Surgeons<sup>5</sup>. Comparisons were made between the two procedural groups for all outcome measures and for complications.

This research protocol was reviewed by the institutional review board of the Indiana University School of Medicine and was judged to be exempt from requiring consents. Candidates applying for the Part II examination of the American Board of Orthopaedic Surgery are informed that the data that they submit as part of the voluntary process of Board certification may be used for research and that the form that they sign during application for the examination gives permission to use case list data for that purpose.

#### Statistical Methods

Parametric comparisons were conducted with use of unpaired two-tailed t tests for two-sample comparisons. Fisher exact tests were performed for contingency tables. The level of significance for all tests was set at  $p < 0.05$ , and p values were rounded to two decimal places. Power analysis and sample size calculation were not appropriate and were not performed for this study.

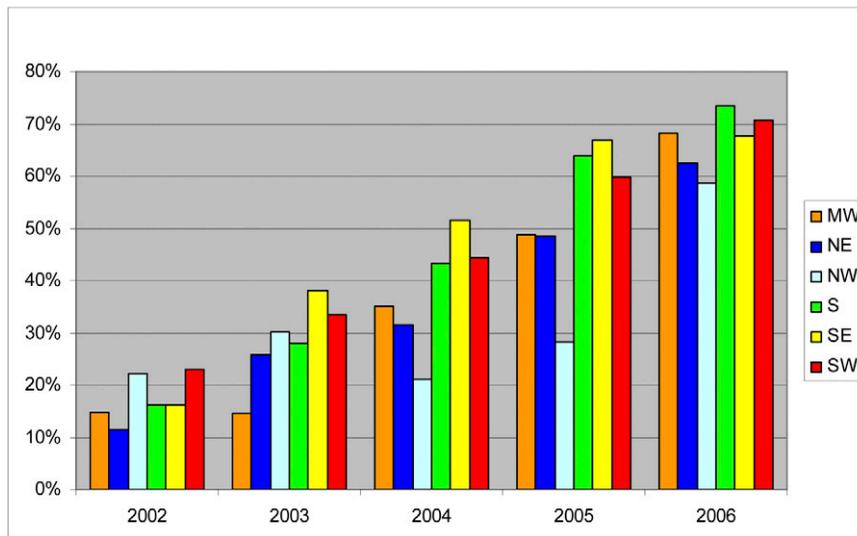


Fig. 2

Bar graph illustrating the percentage of intertrochanteric fractures fixed with intramedullary nails each year in the different regions of the United States. MW = Midwest (Iowa, Kansas, Nebraska, Missouri, Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin); NE = Northeast (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont, New Jersey, New York, Delaware, Maryland, Pennsylvania, Washington DC, Puerto Rico); NW = Northwest (Alaska, Idaho, Oregon, Washington, Montana, North Dakota, South Dakota, Utah, Wyoming); S = South (Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Texas); SE = Southeast (Virginia, West Virginia, North Carolina, South Carolina, Florida, Georgia); and SW = Southwest (New Mexico, Oklahoma, Arizona, California, Hawaii, Nevada, Colorado).

## Results

From 1999 to 2006, a total of 18,720 intertrochanteric femoral fractures (ICD-9 codes 820.20 and 820.21) were treated surgically by candidates during the case collection periods of each year. A total of 5501 candidates submitted case

lists, 1678 of whom performed no operative fixation procedures for this type of fracture. We do not have any information about the cases in which nonoperative treatment was used. Thus, the 18,720 fractures were internally fixed by 3823 candidates, who performed an average of five such procedures each

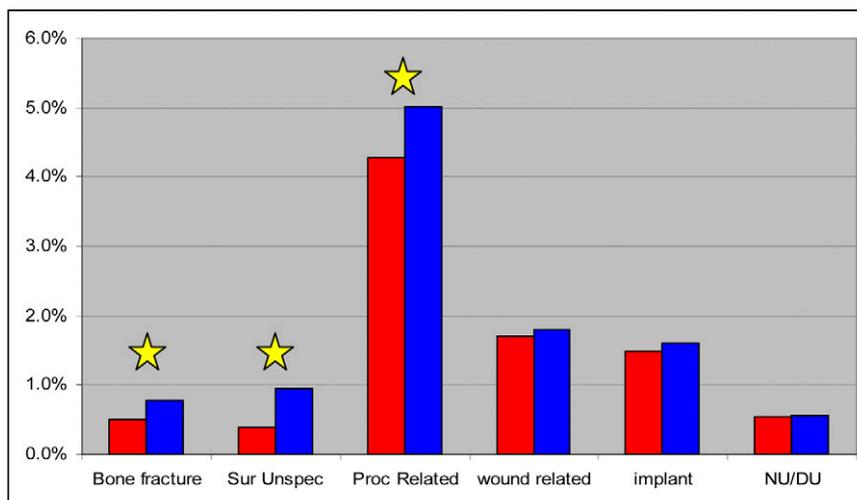


Fig. 3

Bar graph illustrating the complication rates for patients managed with a compression hip screw device (red bars) and patients managed with an intramedullary nail (blue bars). See Table I for list of complications and groups. Sur Unspec = surgical complication unspecified, NU = non-union, and DU = delayed union. Stars represent p values of <0.05.

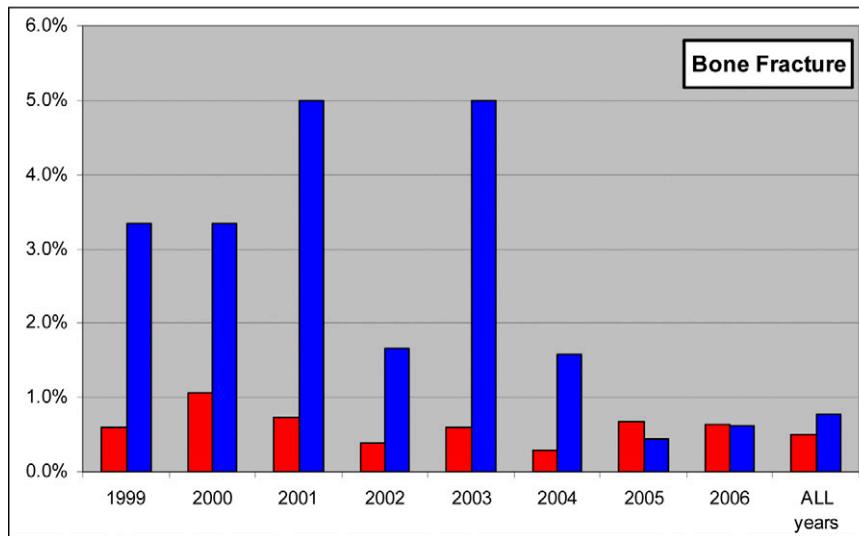


Fig. 4-A

Bar graphs illustrating the time-course of the rates of bone fracture (Fig. 4-A) and procedure-related complications (Fig. 4-B) over the period of 1999 to 2006 for patients managed with a plate (red bars) and patients managed with an intramedullary nail (blue bars).

(range, one to forty-seven procedures) during their six-month case collection period.

Over this period of time, a dramatic shift in surgical technique occurred among the groups of surgeons who were candidates for American Board of Orthopaedic Surgery certification. The use of intramedullary fixation technique increased from approximately 3% nationwide in 1999 to >65% in 2006, with the most dramatic increases being in the last four years (Table II, Fig. 1).

While nearly all areas of the country made this transition from the use of a sliding compression hip screw and side plate to intramedullary nail fixation, the transition did not occur at the same pace or to quite the same extent in all regions (Fig. 2). Surgeons in the Southeast region were quicker to change to intramedullary fixation, whereas those in the Northwest were the slowest to change.

The average pain scale rating was 3.25 for patients managed with a sliding compression hip screw and side plate,

compared with 3.21 for those managed with an intramedullary nail ( $p < 0.0001$ ). The average functional score was 2.94 for patients managed with a sliding compression hip screw and side plate, compared with 2.96 for those managed with an intramedullary nail ( $p = 0.05$ ). The average deformity score was 3.31 for patients managed with a sliding compression hip screw and side plate, compared with 3.28 for patients managed with an intramedullary nail ( $p = 0.01$ ). The average patient satisfaction score was 3.21 for patients managed with a sliding compression hip screw and side plate, compared with 3.22 for patients managed with an intramedullary nail ( $p = 0.47$ ).

There was a slightly higher overall complication rate among patients managed with intramedullary nail fixation (18.6% compared with 18.1%), but this difference was not significant. There were significant ( $p < 0.05$ ) increases in the rates of bone fracture, unspecified surgical complications, and procedure-related complications for patients managed with

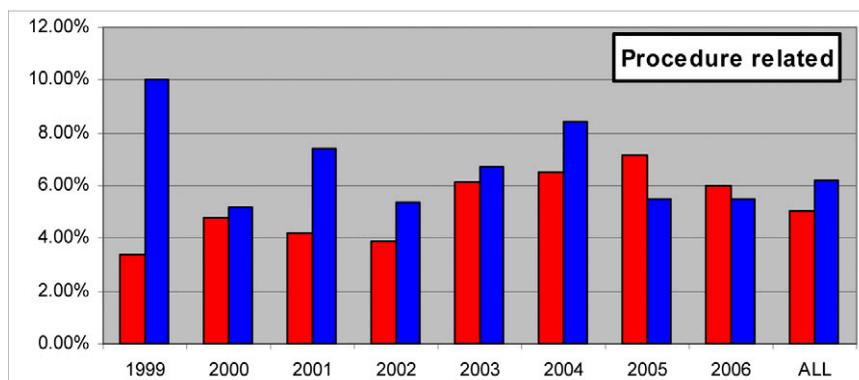


Fig. 4-B

intramedullary nail fixation as compared with those managed with a compression hip screw and side plate over the entire period (Fig. 3). There was no complication category or group in which the plate fixation group had a significantly higher rate than the intramedullary nail fixation group. That is, patients managed with an intramedullary nail had a higher or equivalent rate of every complication and complication grouping analyzed. The trend over recent years suggests that complication rates for intramedullary nail fixation may be declining (Fig. 4).

### Discussion

While a wide range of proximal femoral fracture fixation devices have been employed over the years, the sliding compression hip screw and side plate, which has a blunt end to decrease femoral head penetration and screw threads to increase head purchase, became the implant of choice for the fixation of intertrochanteric fractures in the latter half of the twentieth century<sup>6-11</sup>.

Antegrade intramedullary nailing of intertrochanteric fractures with use of a short nail through which a large screw was inserted into the femoral neck and head for interlocking was introduced by Halder in the 1980s in the form of the Gamma nail<sup>3</sup>. This device was designed by Grosse and Kempf in Strasbourg, France. Early reports suggested some substantial advantages in association with this type of fixation, including a minimally invasive surgical technique, shortened operating times, decreased blood loss, improved biomechanics, greater stability of fixation, earlier patient mobilization, and shorter lengths of stay<sup>12-15</sup>. However, there was a high rate of technical complications, including fracture of the femur distal to the nail<sup>15-17</sup>. The device was redesigned in 1997 to become the Trochanteric Gamma nail, with a smaller lateral bend, a shorter overall length, and only one distal interlocking screw. A longer, full-length version of the nail was also developed. Several other companies have developed versions of this device.

Sliding compression hip screws have been directly compared with intramedullary fixation in many studies. The results have often been contradictory; for example, some studies have demonstrated a longer operating time in association with nail fixation<sup>16-21</sup>, whereas others have demonstrated a shorter operative time in association with nail fixation<sup>22,23</sup>. The only consistent differences found between the two fixation techniques seem to be an increased rate of complications (particularly intraoperative and postoperative fractures) and a higher rate of reoperation in association with intramedullary nailing<sup>4,16,17,24-28</sup>. The largest meta-analysis of this issue that has been published to date reviewed twenty-seven prospective randomized studies, involving a total of 4588 patients, in which short nails were compared with sliding compression hip screws<sup>29</sup>. The authors' conclusions were that sliding compression hip screw and side plate fixation resulted in fewer intraoperative and postoperative femoral fractures, fewer technical complications, and fewer reoperations. There was no difference between the two techniques in terms of cutout of the screw, nonunions, infections, or mortality. The data were in-

adequate for definitive statements regarding operative time, blood loss, wound complications, radiation exposure, or limb shortening, but there seems to have been no difference. There were inadequate data to comment at all on functional outcomes.

Some authors have suggested that intramedullary hip screw fixation is superior for certain subsets of patients, particularly those with fractures that are "unstable," such as fractures with reverse obliquity patterns, fractures with lateral wall or posteromedial comminution, and fractures extending into the femoral neck or subtrochanteric regions. These types are not well controlled by the sliding compression hip screw and side plate, and they are associated with a high rate of fixation failure when treated with that type of implant<sup>30-32</sup>. The belief that intramedullary fixation will be more successful for the treatment of such fractures is based on biomechanical principles, cadaver studies<sup>33,34</sup>, and clinical series<sup>13,26,35</sup>. One meta-analysis of eleven studies that specifically focused on unstable fractures (Orthopaedic Trauma Association classification 31-A3) suggested that the failure rate associated with trochanteric nails was significantly lower than that associated with plate and screw fixation<sup>36</sup>, although that finding was based on only two studies and the strength of recommendation was graded "B." Another meta-analysis of twenty-four studies involving 3279 fractures in which the sliding compression hip screw and side plate was compared with the short femoral nail demonstrated no evidence of a reduced rate of failure in association with the use of intramedullary nail fixation for unstable fractures<sup>37</sup>. Although it is a common expert opinion that nail fixation is superior to sliding compression hip screw and side plate fixation for the treatment of unstable fractures, this point is not well proven.

The scientific evidence, at least in the English-language literature, does not support the superiority of intramedullary nail fixation over standard sliding compression hip screw and side plate fixation for the treatment of intertrochanteric femoral fractures<sup>29</sup>. In fact, the consensus from the orthopaedic literature is that intramedullary nail fixation is associated with a higher complication rate and no better outcomes<sup>4,16,17,24-29,37</sup>. Our data, which were collected from young orthopaedic surgeons in the beginning of their careers, confirm a higher rate of fracture and procedure-related complications and, at best, equivalent pain and deformity scores at the time of follow-up for patients managed with intramedullary nail fixation. However, our data show that intramedullary nail fixation has overtaken plate fixation rapidly among younger orthopaedic surgeons. Due to the higher rate of surgical complications, it is possible that some patients have had adverse effects because of this change in practice. In addition, implant costs alone are estimated to be two to four times higher for intramedullary nail fixation<sup>38,39</sup>. Thus, the change in fixation method had come in the face of equivalent or worse outcomes and higher implant costs and surgeon reimbursement rates (as discussed below).

We do not know for sure why these practices have changed so dramatically in such a short period. There are many possible influences, and the cause is probably multifactorial. Many surgeons believe that intramedullary fixation is quicker, easier,

and more stable and offers improved patient mobility, despite the fact that the English-language literature does not support these claims. It is possible that there has been a change in the nature of intertrochanteric fractures and that the changed practice patterns reflect a difference in the patient population. Perhaps more unstable or comminuted fractures have been seen in recent years because of an aging active population. Unfortunately, we cannot evaluate this possibility because we do not have any details about the fractures beyond the ICD-9 codes.

It may be that younger surgeons are responding to a change in training and that for some reason residents are currently being trained preferentially in intramedullary fixation of intertrochanteric fractures. There may be an intrinsic attraction to new fixation devices and surgical techniques. Younger surgeons may be under certain pressures to offer new techniques in a medical market that is constantly searching for the latest in technology. It is possible that concerns about medical liability may cause some surgeons to use intramedullary fixation in all cases, lest they be faulted for misjudging the stability of a fracture that displaced after plate treatment.

It is also possible that one factor driving this change may be the difference in the relative value units associated with the two techniques. According to the 2007 Relative Value Scale, plate fixation (CPT code 27244) is worth 29.61 total relative value units, whereas nail fixation (CPT code 27245) is worth 36.14 total relative value units<sup>40</sup>. With use of a Medicare conversion factor of approximately \$36 per relative value unit, the difference between the two procedures results in a pay differential of approximately \$235 in favor of intramedullary nail fixation.

Our study has multiple limitations. The data were obtained from the practices of young surgeons who had completed five years of surgical training and had been, on the average, in independent practice for two to three years. It would be hazardous to generalize any of the findings to the entire body of practicing orthopaedic surgeons. A major limitation is the portion of the study that relies on outcomes data entered by the candidates. As noted above, the four outcome scales (pain, function, deformity, and patient satisfaction) are not clearly defined, are not scientifically validated, and are dependent on subjective judgments that are reported by the candidate sur-

geon. The outcome scales are applied by the surgeons, who may have a stake in better outcomes, and they are applied at variable, but short, times after surgery. While these limitations are true, we believe that they would apply equally to patients managed with an intramedullary nail or a compression hip screw. There is no reason to suspect that candidates would apply judgments in a selective way to favor one implant over another. The criticism of subjectivity and bias may also apply to the surgeons' reporting of complications. Since the follow-up of these patients is variable and short, it is quite possible that all complications were not detected and that outcomes would change with time. We do believe that, because of the rather high-stakes nature of the American Board of Orthopaedic Surgery examination and the awareness that they will have to present and defend a certain number of cases, candidates likely go to great length to be accurate and honest. The candidates know that twelve of their cases will be selected for intense scrutiny and that they will have to produce radiographs and medical records. Should they be found to have falsified an outcome, the consequences could be a failure to become Board-certified and a prohibition from reapplying for some time.

In conclusion, a striking shift in fixation strategy for intertrochanteric femoral fractures has occurred over a brief period of time among younger orthopaedic surgeons. This has resulted in higher implant costs and surgeon fees, with no improvement in patient outcomes. We believe that the difference in relative value units between the two surgical technique alternatives for the same condition should be carefully scrutinized and that any differences should be based solely on measured differences in work. ■

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