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Short Versus Long Cephalomedullary Nails for Pertrochanteric Hip Fractures: A Randomized Prospective Study

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Objective: To compare functional and clinical outcomes in patients with pertrochanteric hip fractures treated with either a short (SN) or long (LN) cephalomedullary nail.

Design: Prospective, randomized.

Setting: Clinical investigation was performed at the Mayo Clinic's Level 1 Trauma Center in Rochester, MN.

Patients/Participants: Two hundred twenty patients with intertrochanteric fractures were prospectively randomized to an SN or LN cohort. A total of 168 patients (SN, n = 80; LN, n = 88) had a mean follow-up of 13.9 months. Fifty-two patients did not meet the minimum 3-month follow-up. Demographics were comparable between the cohorts.

Main Outcome Measures: The primary outcome measurement was functional outcome evaluated by Short Form (SF-36) and Harris Hip scores (HHS) at 3 months. Secondary outcomes included implant failure, peri-implant fracture, mortality, operative time, estimated blood loss, and reoperation.

Results: SN and LN cohorts were comparable in all aspects of the SF-36. There was a clinically insignificant difference in the HHS between cohorts. Patients treated in the SN cohort experienced shorter operative times but did not differ in tip-to-apex distance or subtrochanteric fracture extension. There was no difference in implant cutout, deep surgical site infection, or peri-implant fractures.

Conclusions: Patients treated with SNs or LNs for pertrochanteric femur fractures experienced comparable functional outcomes as measured by SF-36 and HHS. When compared with the LN cohort, SN patients experienced no difference in peri-implant fracture or lag-screw cutout and tolerated up to 3 cm of subtrochanteric fracture line extension.

Key Words: pertrochanteric hip fracture, intertrochanteric hip fracture, cephalomedullary nail

Level of Evidence: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

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INTRODUCTION

Patients presenting with pertrochanteric femur fractures is common in any hospital system, and the incidence of these fractures is only expected to increase in the coming decades.[1–5] Cephalomedullary nailing has emerged as the most popular surgical technique for the treatment of pertrochanteric femur fracture patterns in the past decade.[6,7] Numerous nail implant styles exist—including variations in the length of the implant. These so-called short and long nails (SN and LN) are both used in the treatment of pertrochanteric femur fractures.

There is no current consensus to which implant length is the optimal choice for these fractures. Some surgeons claim SNs lack adequate diaphyseal fixation leading to increased pain or fracture risk at the tip of the implant.[8–12] Historically, there has been a concern for increased risk of iatrogenic anterior cortical perforation and possible complex distal femur fractures, but the radius of curvature has improved with newer generation LN designs.[13] Prospective studies have analyzed potential functional differences between cephalomedullary nails and sliding hip screws; however, it is unknown if the use of an SN versus an LN results in any difference in functional outcome.[14] To date, no prospective studies have compared the SN and LN in regards to functional outcomes, implant cutout, and peri-implant fracture.

The purpose of this study was to compare functional outcome scores between patients with pertrochanteric hip fractures treated with either a short or long cephalomedullary nail. Secondarily, we sought to compare the rate of perioperative and implant-related complications between the 2 designs.

PATIENTS AND METHODS

This prospective, randomized, clinical trial was approved by our institutional review board and registered at clinicaltrial.gov. The study was performed at a single,

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academic, Level-1 trauma center from December 2014 to December 2017 with 3-month minimum follow-up for functional outcomes (mean, 13.9 months; range, 3–33 months). Three-month minimum follow-up was chosen for the 2 following reasons. Previous literature has demonstrated that the majority of failures due to cutout of the lag screw occur within 3 months of the index operation.[15–19] Additionally, given the mortality of 20%–30% in this population after fracture within the first year, we would inherently exclude a large portion of patients with healed fractures that had expired.[3,4] Although we acknowledge that functional outcome scores may continue to improve in those patients who are alive at 1 year,[20] we sought to compare outcomes between 2 groups of patients who both had sustained hip fractures; thus, it can be assumed that their functional outcomes at 3 months would otherwise be equivalent with the exception of the primary treatment (LN vs. SN). Eligible patients agreeing to participate were informed that they would be randomized to an SN or an LN. Inclusion criteria included patients with isolated OTA/AO 31(A) (1–3) pertrochanteric femur fractures and age ≥18 years.[21] Exclusion criteria were patients <18 years old, dementia limiting the ability to engage in patient-reported outcomes, and pathologic fracture.

A priori power analysis was performed for the primary outcome variable and demonstrated that 80 patients would be needed in each cohort to obtain 80% power to detect a difference of 6% [Short Form (SF)-36] in the means between the 2 cohorts (effect size = 0.45), with a 2-sided significance level of 0.05. A 6% difference in the SF-36 score was selected due to the previous literature suggesting a minimally clinical important difference of 6%–10% for the SF-36.[22,23]

To account for patients lost to death or follow-up, we planned to enroll a total of 110 patients per cohort (220 total, see **Figure**, **Supplemental Digital Content 1**, http://links.lww.com/JOT/A745). A computer-generated randomization scheme was used to allocate patients by blocked randomization strategy. There was an obvious visible difference between use of an SN and an LN; therefore, surgeons were not blinded to the implant. Due to the presence or absence of incisions at the distal thigh (for an LN), the patients were not able to be blinded to the treatment. Three different implants were used at the discretion of the surgeon. All 3 are titanium implants of similar design: a trochanteric start nail with a large proximal body, a radius of curvature more closely matched to the native femur, a large proximal lag screw that may be statically or dynamically locked, and holes for placement of distal interlocking bolts at the end of the nail. The majority of patients received the DePuy Synthes TFN-a nail (Paoli, PA) (53%), followed by the Stryker Gamma 3 (Mahwah, NJ) (40%) and Biomet Affixus (Warsaw, IN) (7%). There was no difference observed in implant use for the SN cohort (60% TFN-a, 35% Gamma, 5% Affixus) and LN cohort (45% TFN-a, 45% Gamma, 9% Affixus; $P = 0.15$). One distal interlocking screw was used for each SN and 2 for each LN. Only cephalomedullary screws were used with the TFN implant, and no blades were used in patients for proximal fixation.

Of the 220 patients enrolled, 52 were unable to complete 3-month follow-up (see **Figure**, **Supplemental Digital Content 1**, http://links.lww.com/JOT/A745). There were 168 patients who met study criteria with 80 patients in the SN cohort and 88 patients in the LN cohort. Demographics were comparable in age, time from admission to surgery, gender, body mass index, tobacco use, diabetes, chronic kidney disease, American Society of Anesthesiologists, and OTA/AO fracture classification (see **Table**, **Supplemental Digital Content 2**, http://links.lww.com/JOT/A748). There was no difference in time from admission to surgery with the mean time to surgery being 21 hours for all patients, and no difference observed between the SN (23 hours) and LN (19 hours; $P = 0.11$) cohorts. Fracture pattern distribution was similar between both the SN and LN cohorts with the majority of fractures being OTA/AO 31-A2 (SN = 76%; LN = 76%; see **Table**, **Supplemental Digital Content 2**, http://links.lww.com/JOT/A748). Subtrochanteric fracture line extension was measured (S.F.S., B.J.Y., W.W.C., J.D.B., S.A.S.) from the most prominent aspect of the lesser trochanter to the distal extent of the fracture line. In cases where the lesser trochanter was fractured, the preinjury location was estimated using the anteroposterior radiograph of the uninjured hip as a template. Mean subtrochanteric fracture line extension was 1.89 cm [95% confidence interval (CI), 1.56–2.21; range 0–4.5 cm] for the SN cohort and 2.15 cm (95% CI, 1.82–2.48; range, 0–6.5 cm) for the LN cohort ($P = 0.24$). Patients with subtrochanteric fracture extension of >3 cm from the tip of the lesser trochanter were excluded from enrollment. However, we had 20 patients with subtrochanteric fracture extension of >3 cm included in the study (9 SN—4 Gamma nails and 5 TFN-a nails and 11 LN). In most cases, this was due to incomplete visualization of true fracture extension until the fracture had been reduced. These patients were included in the analysis despite the deviation from planned protocol.

All patients were positioned supine on a fracture table, and closed reduction under fluoroscopy was obtained with manual traction and rotation before fixation. The supervising surgeon was 1 of the 4 traumatologists for 70% of the SN patients and 76% of the LN patients with the remaining patients being covered by general orthopaedic surgeons ($P = 0.38$). The cephalomedullary screw was positioned as central in the femoral head as possible in both coronal and sagittal planes and within 5–10 mm of subchondral bone.[19] Tip-to-apex distance was similar between the SN and LN cohorts (Table 1). There was no difference in nail diameters between the cohorts.

The primary outcome variable was the difference in SF-36 and Harris Hip scores (HHS) between the SN and LN cohorts at 3 months. Follow-up occurred at 2 weeks for suture/staple removal and clinical/radiographic follow-up at 6 weeks, 3 months, 6 months, and 12 months. At follow-up, patients were assessed for the incidence of implant complications. Failure of fixation was defined as cutout or penetration of the screw/blade into the hip joint or catastrophic implant failure.

Continuous variables are presented as means with 95% CI and were compared using unpaired 2-tailed Student *t* tests. Categorical variables and proportions were compared with

TABLE 1. Operative Details Short Versus Long CMN

	Short Nail (n = 80)	Long Nail (n = 88)	*P*
TAD, mm	18.3 (17.2–19.4)	18.8 (17.7–19.7)	0.51
Traumatologist, %	70	76	0.38
Subtrochanteric fracture line extension, cm	1.89 (1.56–2.21)	2.15 (1.82–2.48)	0.24
Operative time, min	51 (48–55)	80 (74–87)	<0.0001*
Estimated blood loss, mL	70 (61–79)	207 (185–229)	<0.001*

*Statistically significant.
CMN, cephalomedullary nail.

Fisher exact and χ^2 tests. Receiver operator characteristic analysis was performed on all continuous variables to determine whether a threshold was present and predictive of loss of fixation, with corresponding area under the curve reported. All statistics calculations were made using JMP Version 10 (Statistical Analysis Software, Cary, NC) with statistical significance set at $P < 0.05$.

RESULTS

Functional Outcomes

Of the 220 patients enrolled, 168 were available for clinical and radiographic follow-up at 3 months. All domains of the SF-36 were similar for both the SN and LN cohorts (see **Figure**, **Supplemental Digital Content 3**, http://links.lww.com/JOT/A746, Table 2). Role limitations due to physical health represented the lowest scores in both cohorts (see **Figure**, **Supplemental Digital Content 3**, http://links.lww.com/JOT/A746, Table 2). The greatest differences in health between study patients and US age- and gender-specific norms were in role limitations due to physical health for SN (mean difference = 59) and LN (mean difference = 63) and physical functioning for SN (mean difference = 56) and LN (mean difference = 57).[24] For all domains except mental health, the scores of both cohorts were significantly worse than the general population ($P < 0.0001$, see **Figure**, **Supplemental Digital Content 3**, http://links.lww.com/JOT/A746). HHS were found to be significantly higher for SN patients (HHS = 76) compared with LN patients (HHS = 71; $P = 0.02$), although a 5-point difference in HHS is not considered a clinically important difference.[25] Patients treated with an SN were also questioned if they had any anterior thigh pain that would correlate to the tip of the SN and a potential stress riser at this region—only 1 patient reported anterior thigh pain, which resolved at 3-month follow-up.

Complications: Peri-implant Fracture, Implant Cutout, and Reoperation

As demonstrated in Table 3, the total number of complications were similar between the SN and LN cohorts (12 of 80, 15% and 12 of 88, 13.6%, respectively; $P = 0.83$). Peri-implant fractures occurred in 2 SN patients and 2 LN patients (2.49% vs. 2.27%; $P = 1.00$; Figs. 1 and 2). Neither of the SN patients with peri-implant fracture had any subtrochanteric fracture line extension on injury or postoperative radiographs. Both peri-implant fractures in the SN patients occurred after a ground-level fall 42 and 45 days out from the initial surgery. Both fractures achieved clinical and radiographic union through nonoperative treatment with touch weight-bearing for 4 weeks, 50% weight bearing for an additional 4 weeks, and then weight bearing as tolerated. Both LN patients experienced displaced peri-implant intra-articular distal femur fractures after sustaining ground-level falls at 21 and 404 days out from the initial surgery. They were treated with open reduction and internal fixation with distal femoral locking plate constructs. One patient went onto clinical and radiographic union of their peri-implant fracture, and the other patient expired due to cardiopulmonary arrest 8 weeks after the second surgery.

Loss of fixation and failure due to cutout occurred in 3.75% (n = 3 of 80) of the SN patients and 2.27% of the LN patients (n = 2 of 88; $P = 0.67$). When evaluating for a tip-to-apex distance (TAD) that would be predictive of failure, receiver operator characteristic analysis determined a TAD

TABLE 2. Functional Outcomes

Variable	Short Nail (n = 80)	Long Nail (n = 88)	*P*
SF-36 score			
Physical functioning	28 (IQR, 23–33)	27 (IQR, 21–33)	0.83
Role limitations due to physical health	22 (IQR, 14–30)	18 (IQR,10–26)	0.56
Bodily pain	63 (IQR, 56–69)	57 (IQR, 51–63)	0.18
General health	63 (IQR, 58–67)	61 (IQR, 56–66)	0.82
Vitality	52 (IQR, 47–56)	46 (IQR, 41–51)	0.13
Social functioning	62 (IQR, 56–69)	61 (IQR, 53–68)	0.79
Role limitations due to emotions	54 (IQR, 44–65)	53 (IQR, 41–64)	0.84
Mental health	76 (IQR, 71–81)	71 (IQR, 66–75)	0.12
Harris hip score	76 (IQR, 74–78)	71 (IQR, 68–74)	0.02*

IQR, interquartile range.
*Statistically significant.

threshold of 28 mm (area under the curve= 0.84). Fifty-six percent (n = 5 of 9) of patients with a TAD of ≥28 mm failed due to cutout, compared with 0% (n = 0 of 159; $P < 0.0001$) of those with a TAD of <28 mm. Nail diameter was not found to be predictive of failure [3% (5 of 153 patients) for an 11-mm nail vs. 25% (1 of 4 patients) for a 12-mm nail; $P = 0.53$]. Nail diameter also had no influence on peri-implant fracture ($P = 1.00$).

Operative time was found to be significantly shorter for the SN cohort (51 minutes) compared with the LN cohort (80 minutes; $P < 0.0001$). Estimated blood loss (EBL) was 70 mL (range, 61–79 mL) in the SN cohort and 207 mL (range, 185–229 mL) in the LN cohort (<0.001). Reoperation for any reason was not found to differ between the SN cohort (6.25%; n = 5 of 80) and LN cohort (9.09%; n = 8 of 88; $P = 0.72$). One LN patient underwent reoperation for nail dynamization due to delayed union. One patient in each cohort experienced a prominent lag screw that required exchange. Three patients with deep infection required formal irrigation and debridement (2 LN and 1 SN; $P = 1.00$).

We critically evaluated the subgroup of patients with subtrochanteric extension—specifically fractures that extended beyond 2 cm, which we had in 99 patients. There were 47 patients treated with an SN with a mean of 2.97 cm (95% CI, 2.77–3.21) and 52 patients treated with an LN with a mean of 3.26 cm (95% CI, 3.02–3.49; $P = 0.54$). There was no difference in failure rate due to cutout between these 2 subgroups with 2 failures in the LN cohort and 3 failures in the SN cohort ($P = 0.66$)—note that all 5 of these patients had a TAD of 28 mm or higher. There was also no difference in reoperation rate for any reason with 5 patients in the SN cohort and 7 patients in the LN cohort requiring reoperation ($P = 0.77$). Of the patients achieving 1-year follow-up (SN, 48 and LN, 54), the 1-year survivorship free of reoperation was 92% for the SN cohort and 91% for the LN cohort (see **Figure**, **Supplemental Digital Content 4**, http://links.lww.com/JOT/A747).

DISCUSSION

The treatment of pertrochanteric femur fractures with a cephalomedullary device has proven to be reliable,[1,2] but there is no consensus on whether an SN or an LN should be used. This randomized prospective trial demonstrates that surgical treatment of OTA/AO 31(A) (1–3) pertrochanteric femur fractures with both short and long cephalomedullary devices results in comparable functional and clinical outcomes. Furthermore, up to 3 cm of subtrochanteric extension can be acceptable for SN use.

TABLE 3. Complications

	Short Nail (n = 80)	Long Nail (n = 88)	*P*
Total complications, %	15.0 (n = 12)	13.6 (n = 12)	0.83
Reoperation for any reason, %	6.25 (n = 5)	9.09 (n = 8)	0.72
Peri-implant fracture, %	2.49 (n = 2)	2.27 (n = 2)	1.00
Lag-screw cutout, %	3.75 (n = 3)	2.27 (n = 2)	0.67
Deep surgical site infection, %	1.25 (n = 1)	2.27 (n = 2)	1.00

Functional Outcomes

Our results demonstrate that functional outcomes of the entire cohort as measured by the SF-36 score were poor for almost all SF-36 domains (Fig. 1).[24] The most significant differences observed compared with the general populace were physical functioning and role limitations due to physical health, which coincides with the previous lower extremity trauma literature using the SF-36 score.[26] The only SF-36 category that was similar to the general populace was mental health. In addition, utilization of an SN or an LN had no influence on any domain of the SF-36. Previous studies have reported overall fair outcomes as rated by the HHS.[27–30] Ocku et al[27] demonstrated fair HHS in their patients with reverse obliquity fractures treated with either an SN or an LN. Our reported HHS were comparable in both the SN and LN cohorts. We did observe a statistical difference in the HHS of 5 points favoring the SN cohort, but this is not clinically significant.[25] When critically evaluating the SF-36 results and HHS, the fair rating given by the HHS (SN HHS = 76; LN HHS = 71) would seem to understate the overall poor clinical picture depicted by our SF-36 results.

Peri-implant Fracture

Early experience with SN designs in the beginning of the 1990s demonstrated concerning rates of fracture at the distal tip of the implants (8%–11%).[11,12,31] Robinson et al[32] reported a 40 times increased risk of periprosthetic/peri-implant fracture in comparison to the general population, and cephalomedullary nails in particular had inferior survivorship (93%) compared with sliding hip screw constructs (98%). But these were older-generation stainless steel implants with less anatomical fit had a significant valgus bend compared with more modern designs. As Bhandari et al[33] demonstrated, the older nail designs may have been responsible for these failures, and in their 2009 meta-analysis, they concluded that peri-implant fracture was not an issue with modern nail designs.

Overall, the modern peri-implant fracture rates reported have been 0%–3.3% for SNs and 0%–1.5% for LNs. In addition, Lindvall et al specifically demonstrated that patients refractured as a result of another fall and the fracture line was never near the end of the SN.[34–38] More recently, in a large retrospective series, Kleweno et al[37] demonstrated a peri-implant fracture rate of 2.7% for their SN patients and 1.5% for LN patients—comparable to our own findings (Table 3). The inherent flaw with previous retrospective case series is the inherent bias for stable fractures to be treated with an SN and unstable fractures to be treated with an LN. Our goal was to ensure that we had comparable stable and unstable fracture patterns in each cohort (see **Table**, **Supplemental Digital Content 2**, http://links.lww.com/JOT/A748). One prospective study randomized patients with reverse obliquity fractures and demonstrated no difference in peri-implant fractures rates between SN and LN (SN = 15, LN = 18).[27] Regardless of fracture type, we found no difference in peri-

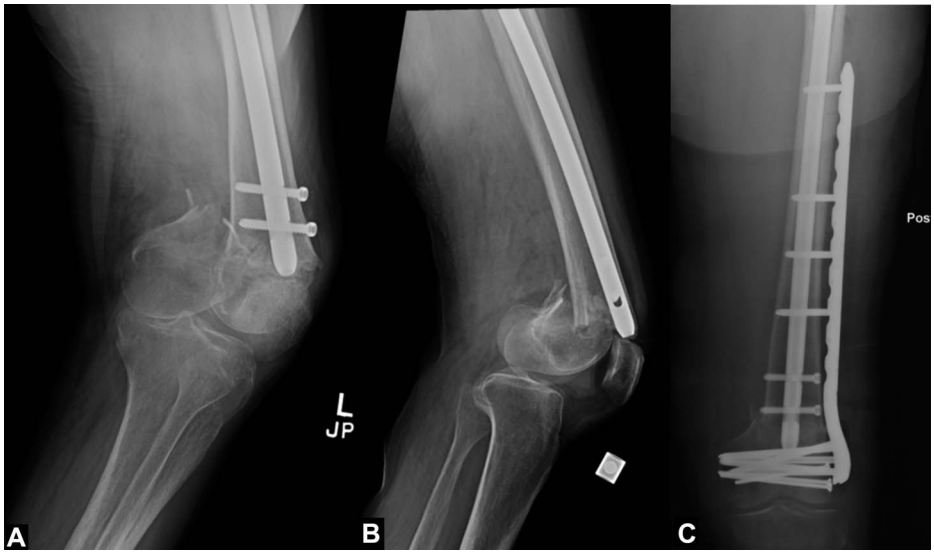

FIGURE 1. An 85-year-old woman with prior LN fixation for a 31-A2 pertrochanteric femur fracture experienced a ground-level fall 404 days out from index surgery, sustaining a peri-implant intercondylar distal femur fracture 33-C2 (A, B) requiring open reduction internal fixation with a distal femoral locking plate construct (C).

implant fracture rates between the SN (2.49%) and LN (2.27%) cohorts.

Previous authors have expressed concern with LN peri-implant fractures resulting in distal femur fractures, requiring the necessity of distal femoral locking plate application.[13,34,36,38,39] Both of our LN patients who experienced peri-implant displaced intercondylar distal femur fractures required open reduction and distal femoral locking plate application. This was in contrast to both of our SN patients whose fractures were nondisplaced intertrochanteric fracture lines and who were successfully treated nonoperatively with a period of progressive weight bearing (Figs. 1 and 2). We also critically evaluated the diameter of the implants used because some authors have suggested that a capacious proximal canal may decrease the stability due to lack of interference fit and toggle.[13] We were not able to determine if nail diameter affected implant stability or risk of peri-implant fracture, as the majority of patients were treated with an 11-mm nail.

Subtrochanteric Fracture Line Extension

Although multiple, recent, retrospective series have demonstrated no difference between union and complication rates for LNs versus SNs, only one addressed subtrochanteric fracture line extension.[35–37] Hou et al found comparable clinical outcomes between their SN and LN cohorts, but no patients in their SN cohort had subtrochanteric fracture line extension. Some authors suggested that subtrochanteric fracture line extension of >1 cm may be a contraindication to use of an SN.[34] Not only were our cohorts comparable for subtrochanteric fracture line extension but also we did not find any increase in the risk of failure due to peri-implant fracture in our SN cohort despite a mean subtrochanteric fracture line extension of 1.89 cm (range, 1.56–2.21 cm). We also looked specifically at subgroups of the SN and LN patients with greater than 2 cm of subtrochanteric fracture line extension and found no difference in reoperation or failure rate, demonstrating that these fractures can safely be treated with an SN despite up to 3 cm of subtrochanteric extension.

Loss of Fixation and Implant Cutout

The most common reason for reoperation for our entire cohort was implant cutout through the femoral head with a 3.0% cutout rate. There was also no difference in implant cutout observed between SN and LN cohorts (Table 3). Kleweno et al found a similar cut out rate of 3% in their large retrospective series, which also coincides with the previous literature.[34–37] The only variable identified to be predictive of failure due to cut was a TAD of 28 mm or greater. The mean TAD for both SN and LN cohorts was similar, and both were less than 20 mm (Table 1). This is consistent with the series presented by Baumgaertner et al[19] who recommend maintaining a TAD of less than 25 mm to prevent implant cutout.

Operative Differences

It is reasonable to assume that LNs would be associated with increased EBL and operative times given time allotted for distal reaming and placing 2 distal interlocking screws. Zhang et al[30] in their meta-analysis of 2431 patients demonstrated increased operative times and greater EBL with LN but no difference in regards to hospital length of stay. Kleweno et al[37] reported that their operative times were significantly longer for LNs (70 $\pm$ 35 minutes) compared with the SNs (51 $\pm$ 22 minutes). Boone et al and Hou et al demonstrated similar findings with their LN cohorts experiencing approximately 13 and 20 minutes longer operative times, respectively.[34,36] We found similar results in our series with LNs experiencing 29 minutes longer operative times. Given the fact of the incision being open longer and distal reaming occurring, it is not surprising blood loss estimates have been reported to be higher with LNs in the literature—our results confirm this finding with the LN patients experiencing on average 130+ mL of blood loss compared with the SN cohort. We do acknowledge that many centers may not find the need to ream with 10-mm nails, which could substantially cut down operative time and EBL. Therefore, it is possible that our findings may be due to the fact that we needed to ream for the majority of our nails (96% were 11-mm LNs)—inherently

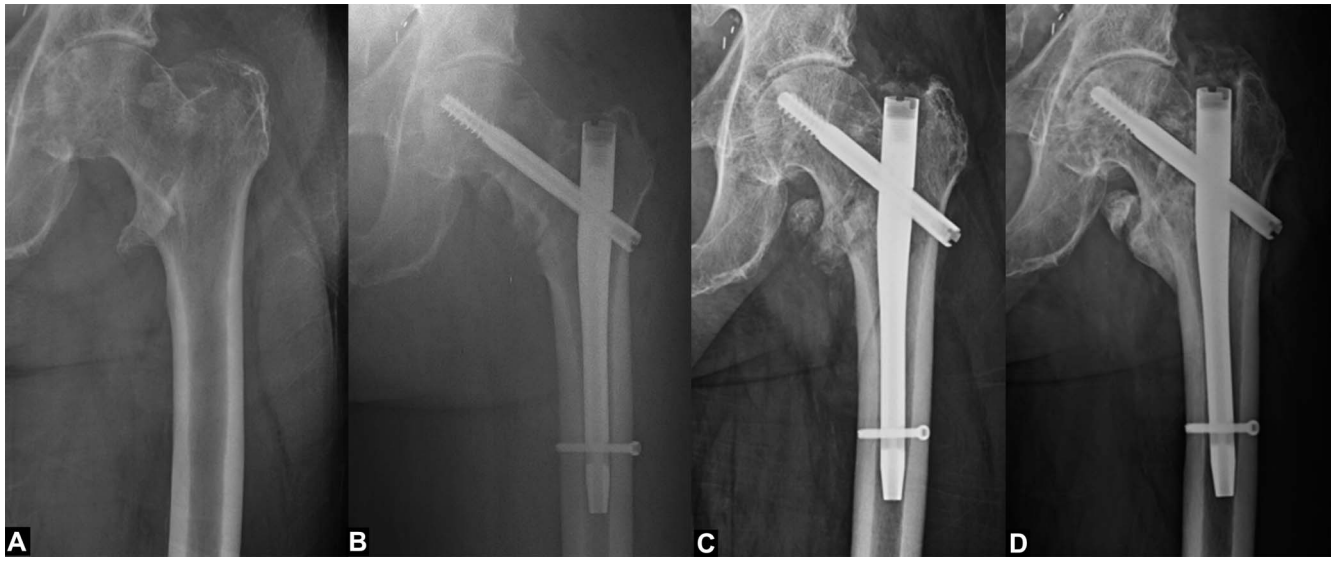

FIGURE 2. A 75-year-old man with a 31-A1 pertrochanteric femur fracture (A) underwent closed reduction and SN fixation (B) with a subsequent ground-level fall 45 days out from the initial surgery, sustaining a peri-implant fracture (C) successfully treated nonoperatively (D).

adding blood loss and operative time for the LN cohort. Reaming may be necessary in younger patients for whom we had a few younger outliers (47–65 years old), but 95% of our patients were 79- to 84-year olds in the SN cohort and 76- to 82-year olds in the LN cohort (see **Table**, **Supplemental Digital Content 2**, http://links.lww.com/JOT/A748).

Prior studies on this topic have been primarily retrospective.[34,36] As pointed out by Horwitz et al,[13] retrospective series are prone to the selection bias for unstable fracture patterns to be treated with LNs. In this prospectively randomized study, we observed similar rates of mechanical failure (cutout) and reoperation despite including an equitable number of complex fracture patterns between both treatment arms. Additionally, this implies that the observed differences in operative time, blood loss, and hospital length of stay may be due to factors other than radiographic severity of the fracture.

There are multiple strengths and limitations to this study. Strengths include the prospective, randomized nature of the study with both simple and complex fracture patterns included in both cohorts. Multiple surgeons participated in the study, increasing the generalizability of the results. The sample size was adequate to investigate the primary research question. Primary limitations of the study include loss to follow-up and inability to blind the surgeon or patient. Additional weaknesses include the following: all of our LN patients received 2 distal interlocks, likely increasing our operative time in the LN cohort, and EBL was estimated from the operative field. Additionally, our study was powered to detect differences in functional outcomes between SN and LN, but not differences in peri-implant fracture occurrence. Because of the low incidence of peri-implant fracture (2.4% in this series), a prospective trial would require thousands of patients to detect a difference in risk of fracture. We also had 20 patients enrolled in the study despite >3 cm of subtrochanteric fracture extension, which had been set as an exclusion criteria a priori. However, including this small number of patients in the analysis did not affect the overall number of complications or reoperations.

CONCLUSIONS

The results of this randomized prospective study further reinforce the findings from previous large retrospective series comparing SN and LN implants for treating pertrochanteric femur fractures: no significant differences exist in clinical or functional outcomes at 3 months with relatively unstable fracture patterns. Although peri-implant fracture incidence was similar between patients treated with an LN and those treated with an SN, fractures below an LN required surgical treatment, whereas those around an SN were managed successfully without surgical treatment. Subtrochanteric extension does not appear to be a contraindication to the use of short cephalomedullary nails, as fractures with extension up to 3 cm were effectively treated with SNs without increased risk of complications compared with LNs.

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