The Clinical and Economic Impact of High-Value Cephalomedullary Nail Utilization at a Level II Trauma Center

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Introduction: In the current climate of cost containment and fiscal responsibility, high-value implant alternatives offer a substantial opportunity for savings in the treatment of orthopedic trauma patients. As patents have expired on many commonly used trauma implants, high-value alternatives have become available. The purpose of this study was to examine the clinical and economic impact of a cost containment program utilizing high-value, single lag screw cephalomedullary hip nail implants for treating intertrochanteric femur fractures.

Design: Retrospective comparative cohort study.
Setting: Level II trauma center
Patients/Participants: 885 patients (347 Males and 538 Females) with intertrochanteric femur fractures.

Intervention: Patients treated with high-value single lag screw cephalomedullary implants were compared to those treated with conventional implants during the same period.

Main Outcome Measurements: Operative records were reviewed to identify intraoperative complications, operative time, and estimated blood loss. Cases involving infection, malunion, nonunion, or the need for repeat surgery were documented. Hospital financial records were evaluated to determine implant costs.

Results: 443 patients were treated with the high-value implant, while 442 patients received conventional single lag screw cephalomedullary implants over the same period. No difference was observed in intraoperative complications or estimated blood loss. Operative time was significantly shorter in the high-value implant group (p=2.3E-10). There was no increase in postoperative infection rates, implant complications, malunion, or nonunion. Overall, the hospital saved a total of $512,994 on implant costs.

Conclusions: Implant costs decreased significantly without an increase in complication rates or changes in radiographic outcomes. These savings were essential to our success in the Bundled Payment for Care Improvement (BPCI) initiative. Additionally, the savings can be reinvested into the trauma program in alignment with OTA/AAOS position statements and guidelines, as well as to support gainsharing and co-management initiatives.

Level of Evidence: Level III - Retrospective comparative cohort study
Keywords: Cephalomedullary nail, Hip fracture, High-value implants, Cost containment, Orthopaedic trauma.

INTRODUCTION

Healthcare costs in the United States continue to increase, and economic pressures on the care of orthopedic trauma patients have never been greater. Value-based healthcare is vital to the survival of our current healthcare system, and using “generic” or “high-value” implants is one possible means of cost containment. Over the past fifteen years, the use of generic prescription medications has markedly decreased care costs while maintaining comparable clinical outcomes. Recently, generic or high-value implants have become available, offering orthopedic surgeons an alternative method for cost savings. Previous studies have examined the availability and effectiveness of high-value implants, as well as their role in cost containment.[1,2] These studies have shown no significant difference in surgical outcomes when comparing high-value and conventional devices, including estimated blood loss (EBL), time to healing, and procedure duration.

The management of hip fractures is of particular interest in healthcare cost control. The incidence of hip fractures in the United States continues to rise with an aging population, surpassing 300,000 cases annually and accounting for 50-70% of osteoporotic fracture treatment expenses.[3,4] It is projected that by 2030, this number will increase by 12%.[4] Recently, there has been more focus

Table 1: Patient demographics

	High Value (n=443)	Conventional (n=442)	p-value
Age (mean +/- SD)	75.3 +/- 13.6	74.5 +/- 15.6	0.50
Gender (% Male)	43.4	38.0	0.11
ASA (mean)	2.8	2.9	0.15
Diabetes (%)	34.8	29.9	0.09
Smoking Status (%)	35.1	39.9	0.14

on reducing healthcare costs related to hip fracture treatment. Strategies include standardized preoperative assessments and medical co-management programs.[3,5,6] The Centers for Medicare & Medicaid Services (CMS) has aimed to promote high-value care for the treatment of hip fractures through the development and implementation of the Bundled Payments for Care Improvement Initiative (BPCI).

The use of high-value single lag screw cephalomedullary nail implants could significantly reduce costs in managing hip fracture patients. Therefore, this study aims to compare these implants with conventional options, focusing on differences in clinical outcomes and cost containment strategies.

METHODS

After obtaining approval from the Investigational Review Board, a retrospective review of patients (2016-2018) treated at a Level II trauma center for an acute intertrochanteric hip fracture was conducted. Our trauma database was reviewed to identify patients who received high-value implants (Orthopaedic Implant Company, Reno, NV). These patients were compared to those treated during the same period with a conventional single lag screw cephalomedullary implant (Stryker, Kalamazoo, MI).

A chart review was performed to gather basic demographic variables such as age, sex, American Society of Anesthesiologists (ASA) score, history of diabetes, and smoking status. Operative records were examined to identify implant type, operative time, estimated blood loss (EBL), and any intraoperative complications. Hospital and clinic records were reviewed to find cases of infection, malunion, nonunion, or the need for repeat surgery. Radiographs were evaluated to document fracture type, implant loosening, healing status, loss of reduction, malunion, or nonunion (Figure 1). Hospital financial records were reviewed to determine the costs of operative implants.

Four trauma fellowship-trained orthopedic surgeons performed all the surgeries at a single level II trauma center. Patients with intertrochanteric hip fractures were treated surgically using standard procedures. The choice of implant and whether to use a short or long single lag screw cephalomedullary device was left to the operating surgeon's discretion. The high-value single lag screw cephalomedullary nail received FDA approval and became available in January 2016. Postoperative care was standardized among surgeons according to hip fracture protocols. All patients were weight-bearing as tolerated immediately after fixation. Follow-up through fracture union included routine office visits and X-rays at 2 weeks, 6 weeks, 12 weeks, 6 months, and 12 months.

All patients underwent a standard series of digital preoperative and postoperative hip and femur radiographs, including AP and lateral views. Two observers reviewed the radiographs to classify fractures according to the Orthopaedic Trauma Association (OTA) system and to confirm the use of a single lag screw cephalomedullary nail fixation. The incidence of implant or fracture-related complications was recorded from the final follow-up radiographs and chart review. Statistical analysis involved a two-tailed t-test for

Table 2: Fracture Classification

Fracture Pattern	High Value Group (n=443)	Conventional Group (n=442)
A1.1	77 (17.5%)	93 (21.1%)
A1.2	84 (19.0%)	60 (13.6%)
A1.3	48 (10.8%)	17 (3.8%)
A2.1	49 (11.2%)	77 (17.4%)
A2.2	28 (6.3%)	35 (8.0%)
A2.3	33 (7.4%)	73 (16.4%)
A3.1	44 (10.0%)	58 (13.1%)
A3.2	33 (7.4%)	17 (3.8%)
A3.3	46 (10.4%)	12 (2.8%)

comparing continuous variables and Fisher's exact test for comparing categorical variables. The Statistical Analysis System, with the assistance of a statistician, was used. A p-value of <0.05 was considered statistically significant.

RESULTS

There were 885 patients (347 men, 538 women) with an average age of 75 years (±14.7). Four hundred and forty-three fractures were treated with a high-value, single lag screw cephalomedullary hip implant, while four hundred and forty-two patients were treated with a conventional nail during the same period. The single lag screw cephalomedullary implants included both long and short nails, with 237 short nails (206 long nails) in the high-value group and 178 short nails (265 long nails) in the conventional group. There were no statistical differences in baseline patient demographics between the groups (Table 1). Distribution of fracture patterns according to the OTA fracture classification is summarized in Table 2.

Table 3: Short Term Outcomes

	High Value (n=443)	Conventional (n=442)	*p*
Op Time	24.9	39.6	<0.001
EBL	17.9	20.6	0.60
LOS	6.7 +/-2.9	6.4 +/-3.1	0.84

EBL: Estimated blood loss (ml)
LOS: Length of stay (days +/- SD)

Operative and hospital length of stay data are shown in Table 3. There was no difference in intraoperative estimated blood loss (EBL) between the groups (p=0.60). The average EBL in the high value group was 17.9 mL, compared to 20.6 mL in the conventional group. The high value group experienced significantly shorter operative times (24.9 minutes) compared to the conventional group (39.6 minutes) (p=2.4E-10). The mean hospital length of stay did not differ significantly between the groups, with 6.7 days for the high value group and 6.4 days for the conventional group (p=0.84). The average follow-up time for patients with implant removal was 12.5 months (+/- 2.1).

There were 13 (2.9%) postoperative fracture or implant-related complications in the high-value group and 18 (4.1%) in the conventional group. This difference was not statistically significant (p=0.50). Complications in the high-value group included 1 distal interlocking screw breakage, 2 malunions with implant failure, 4 nonunions, 2 implant removals for pain, 2 infections requiring operative irrigation and debridement, and 2 re-fractures. In the conventional group, complications included 2 delayed unions, 5 nonunions, 4 implant failures requiring revision surgery, 2 infections requiring operative irrigation and debridement, and 5 implant removals for pain. Long-term outcomes are outlined in Table 4.

Cost analysis is presented in Table 5. The mean cost of intramedullary hip nail implants was $927 for the high-value group and $2,090 for the conventional group. The 442 patients treated with conventional nails incurred $923,655 in implant costs, while the 443 patients treated with high-value nails incurred $410,661. The average savings per case was $1163 when using high-value implants. Total cost savings amounted to $512,994.

DISCUSSION

National health expenditures continue to rise, increasing by 4.3% in 2016 to reach $3.3 trillion. [7] These costs are projected to continue to increase. Hip fracture care accounts for a significant portion of healthcare

Table 4: Long Term Outcomes

	High Value (n=443)	Conventional (n=442)	P value
Implant Failure	3	4	0.70
Implant Removal	2	5	0.25
Infection	2	2	0.99
Delayed Union	1	2	0.56
Nonunion	4	5	0.74
Refracture	2	1	0.56

expenses, making up 50-70% of osteoporotic fracture treatment costs. [3,4] Schousboe et al. reported that the median cost of caring for a hip fracture patient in the first year was $35,536, rising to as much as $50,000 in subsequent years, with the highest contributors being acute hospital stays, Medicare-paid skilled nursing facilities, and outpatient costs. [8] Strategies to reduce these escalating healthcare costs are of utmost interest.

Standardized preoperative testing and co-management programs have shown promise.[3,5,6] A relatively new area that warrants further exploration is the use of high-value, single-lag screw cephalomedullary hip implants. Despite hundreds of articles demonstrating the clinical equivalence of generic medications, only three articles were found on generic or high-value orthopedic implants. Waddell et al. evaluated generic total hip implants in Canada on 150 patients followed over two years. The use of generic implants resulted in improved hip scores and no increase in complication rates.[8] Another article by Althausen et al. evaluated the clinical and economic impact of generic 7.3 mm cannulated screws in treating femoral neck fractures and percutaneous sacroiliac fixation, demonstrating a 70% reduction in implant costs with no difference in clinical outcomes.[1] Finally, McPhillamy et al. assessed generic locking plate use in a similar study, finding a 56% reduction in implant costs with no differences in clinical outcomes.[2]

Our study builds on previous work by documenting the economic benefits of using high-value single lag screw cephalomedullary hip nails, showing similar clinical outcomes. We demonstrate significant cost savings of $512,994 in implant expenses alone, representing a 54% reduction and an average savings of $1158 per case. Notably, our results also reveal a significant difference in operative time: the high-value group had an approximately 13.8-minute shorter mean operative time compared to the conventional group. We hypothesize that this shorter time is likely due to the absence of need for an implant representative to open the desired implant. Implant trays in the high-value system include common nail sizes, eliminating the need for an implant representative. All necessary disposables, such as guide pins and drill bits, are included in the tray, along with all crosslock screws. This eliminates the need to open multiple sterile packages. Additionally, the high-value system is designed for simplicity, with fewer assembly steps, and is intended to operate without sales representation. This system appears to enhance operating room efficiency, with OR time estimated to cost between $16 and $133 per minute. [9,10] A total of 6113 minutes of operating room time were saved using high-value implants, resulting in a direct savings of up to $813,029. Despite many surgeons perceiving no need for implant representatives in most cases, Walker et al. found that 77% of surveyed surgeons reported having an orthopedic implant representative present for the majority of cases, which likely contributes to unnecessary increased implant costs. [11]

Our study contributes to the growing body of literature supporting the use of high-value implants. However, several barriers still hinder the adoption of

Table 5: Cost Data

	Conventional (n=48)	High Value (n=48)	Savings
Mean cost per case	$2090	$927	$1163
Annualized Cost	$923,655	$410,661	$512,994
			$p<0.001$

high-value implants. The most significant obstacle remains the lack of surgeon confidence and a general reluctance to adopt these implants. Walker et al. evaluated surgeon attitudes toward using generic implants in a 2016 survey. While 75% of respondents were aware of generic orthopedic implants, only 25% actually used them in practice. In contrast, 96% of the same respondents regularly prescribe generic medications. The most commonly cited reasons for not trying high-value implants were satisfaction with current implants, lack of financial incentives to change, and concerns about the track record of generic implants.[11]

Co-management and gainsharing programs may play a significant role in reducing healthcare costs and motivating orthopedic surgeons to choose less costly high-value implants. As described by McBride and Althausen, co-management agreements can help physicians and healthcare systems collaborate to manage a specific hospital service line. This approach is most commonly used in orthopedics, cardiology/cardiothoracic surgery, and general surgery. These agreements compensate physicians for their time, expertise, and development of treatment algorithms. Establishing such relationships can save hospitals millions of dollars.[12] Gainsharing programs, like the BPCI initiative, show potential for controlling healthcare expenses while incentivizing orthopedic surgeons to select cost-effective implants, develop efficient care plans, and innovate programs. High-value implants are crucial in achieving cost savings that benefit patients, hospitals, insurance providers, and physicians, who are financially rewarded for their efforts.[12] Limitations of this study include its retrospective design, small patient sample size, and the involvement of multiple treating surgeons. Furthermore, implant choice (value-based versus conventional; short versus long) was left to the discretion of the operative surgeon, which can introduce treatment bias.

Figure 1: Example of a high value hip nail (Orthopaedic Implant Company, Reno NV.)

CONCLUSION

In conclusion, the use of high-value single lag screw cephalomedullary nails has been a highly successful transition for our institution, resulting in a 54% reduction in implant costs compared to conventional implants. This translates to an average savings of $1158 per case and total savings of $512,994

over the study period. Savings are even greater when considering the reduced surgical time associated with the use of high-value implants. Hospital implant costs decreased significantly without any increase in fracture or implant-related complications. The orthopedic surgeon has a vital responsibility to positively influence the rising costs of healthcare. High-value implants, combined with co-management programs and gainsharing agreements, will be essential in maintaining patient care standards while reducing healthcare expenses in the constantly evolving and complex healthcare delivery system.

DISCLOSURES

One of the authors (PA) has stock ownership in Zeda Holdings, Inc.

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