Cost-Saving Innovation: Talon Distal Locking Speeds Up Humeral Nailing

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Background: Humeral fractures are common and increasing due to an aging population. Intramedullary nailing is less invasive than plating. Traditionally, distal locking is achieved with screws placed under fluoroscopy. Newer nails feature internal talons, reducing the number of operative steps.

Purpose: This study compares operative and fluoroscopy times between standard screw (SS) and talon distal-locking (TF) systems for intramedullary nailing of humeral fractures.

Methods: This is a retrospective comparative study of 99 humeral fractures treated with intramedullary nailing by three orthopaedic trauma surgeons at a single Level II regional trauma center (2017–2021). Polytrauma patients undergoing simultaneous procedures were excluded. Operative time (from anesthesia records) and fluoroscopy time (from C-arm dose reports) were compared between groups using multivariate analysis of variance (MANOVA).

Results: Thirty-nine standard screw (SS) and 60 talon fixation (TF) humeral nail cases were analyzed. The TF group had significantly shorter operative time than the SS group (53.32 ± 17.92 vs 64.62 ± 16.74 minutes; mean difference 11.30 minutes; 95% CI 4.17–18.43; $p = 0.002$). Fluoroscopy time was lower in the TF group but did not differ significantly (90.88 ± 43.12 vs 99.83 ± 41.52 seconds; $p = 0.309$). The operative-time reduction corresponds to an estimated ~$618 per case.

Conclusions: Talon distal locking was associated with an 11-minute reduction in operative time versus interlocking-screw fixation, with comparable fluoroscopy time, suggesting potential intraoperative efficiency and cost benefits. Clinical outcomes were not assessed; a prospective, multicenter study is warranted.

Level of Evidence: Level III; Retrospective Comparative Study

Keywords: humeral fracture; intramedullary nailing; distal locking; talon; operative time; fluoroscopy; cost; surgical efficiency

INTRODUCTION

Humeral shaft fractures account for 5% of all fractures in the United States each year. They have a bimodal distribution, occurring in young, active individuals after high-energy trauma and in older adults with osteoporosis after low-energy falls. In elderly patients, especially those with dementia, surgical fixation has been associated with lower morbidity and improved quality of life compared with conservative management[1,2]. This may be partly due to the difficulty older adults have with immobilizing a limb for prolonged periods.

The U.S. population is aging rapidly; for the first time in the nation's history, adults aged 65 and older are projected to outnumber children[3], a demographic shift accompanied by a rising incidence of osteoporosis[4]. As a result, the number of fractures is projected to increase from 1.9 to 3.2 million by 2040. Associated annual costs are expected to rise from $57 to $95 billion[5]. In this context, even modest improvements in surgical efficiency can have a meaningful clinical and economic impact on our increasingly strained healthcare system[4].

Surgical fixation of humeral shaft fractures traditionally involves plating or intramedullary nailing[6,7]. Intramedullary nailing (IM) is considered the less invasive option, with the added benefits of shorter operative times, smaller incisions, and reduced blood loss[8,9,10]. Traditionally, these nails have been secured with distal interlocking screws placed under fluoroscopic guidance. However, in recent years, there has been increased use of newer nails with distal interlock systems that deploy talons from within, eliminating the need for interlocking screws and resulting in fewer

incisions, less blood loss, decreased radiation exposure, and faster operating times[11]. The purpose of this study was to compare surgical duration and fluoroscopy exposure time between humeral nail systems that use percutaneous distal locking screws and those that use distal talon fixation. We hypothesized that talon fixation would reduce both surgical duration and fluoroscopy exposure time.

MATERIALS AND METHODS

After Institutional Review Board approval, we retrospectively reviewed patients who underwent intramedullary nailing of a humeral fracture using either standard distal interlocking screws or a distal talon fixation system. Procedures were performed by three orthopaedic trauma surgeons at a single Level II regional trauma center between 2017 and 2021. Patients undergoing simultaneous procedures for polytrauma were excluded. The final cohort included 99 cases. Patient demographic characteristics, including age and sex, were not collected or included in the analysis. Operative time was obtained from anesthesia records, and fluoroscopy time was obtained from C-arm dose reports. Fixation groups were compared using multivariate analysis of variance. Statistical analyses were performed using SPSS.

RESULTS

Ninety-nine patients were included: 39 treated with standard screw fixation (SS) and 60 with talon fixation (TF). Operative time was significantly shorter in the TF group than in the SS group (53.32 ± 17.92 vs 64.62 ± 16.74 minutes; mean difference, 11.30 minutes; 95% CI, 4.17–18.43; p = 0.002). Mean fluoroscopy time was also lower in the TF group, although the difference was not statistically significant (90.88 ± 43.12 vs 99.83 ± 41.52 seconds; p = 0.309) (Table 1).

The overall multivariate effect of fixation type on operative and fluoroscopy times was significant (Wilks' $\lambda = 0.907$, $F[2, 96] = 4.935$, $p = 0.009$; partial $\eta^2 = 0.093$). A priori power analysis indicated that 93 participants would provide 80% power to detect a medium effect size at $\alpha = 0.05$; therefore, the sample of 99 patients was considered adequately powered.

Table 1: Operative Time and Fluoroscopy Time by Nail Type

Group	N	Mean ± SD	p
Operating time (minutes)			
Standard fixation (SS)	39	64.62 ± 16.74	0.002
Talon fixation (TF)	60	53.32 ± 17.92	
Total	99	57.77 ± 18.25	—
Fluoroscopy time (seconds)			
Standard fixation (SS)	39	99.83 ± 41.52	0.309
Talon fixation (TF)	60	90.88 ± 43.12	
Total	99	94.41 ± 42.51	—

MANOVA: Wilks' λ = 0.907, p = 0.009. Operating-time difference significant (p = 0.002); fluoroscopy-time difference not significant (p = 0.309). SS, standard interlocking-screw fixation; TF, talon distal-locking fixation.

DISCUSSION

The aging U.S. population, combined with projected increases in osteoporosis-related fractures, underscores the importance of deliberate surgical interventions that reduce patient risk, minimize unnecessary operating room costs, and relieve resource strain on the healthcare system[12]. According to a systematic review of published articles on the cost of time in the operating room and anesthesia, the combined mean operative cost per minute is approximately $54.66[13,14]. The findings of this retrospective study demonstrate that, compared with standard interlocking screw fixation, using a distal talon fixation system for intramedullary nailing of humeral fractures results in an estimated $618 per surgery reduction in time-based operating and anesthesia costs, attributable to

significantly shorter operative times, with a mean reduction of 11.3 minutes ($p = 0.002$). This reduction in operating time aligns with the design improvement of talon deployment, which eliminates the additional traditional distal incisions and negates the need for targeted screw placement, which can be technically challenging and time-consuming[15]. Additionally, at the facility where this study was performed, the talon nail was reported to be less expensive than other humeral nails; however, implant pricing is institution-specific, was not formally analyzed in this study, and may not generalize to other settings.

Fluoroscopy time did not differ significantly between groups ($p = 0.309$), suggesting that overall imaging requirements for fracture fixation are similar across distal fixation methods. However, as noted above, achieving perfect circles can be challenging, especially in centers with low trauma volumes. The time required for X-ray technicians to move the C-arm and obtain perfect circles is not captured in the fluoroscopy time measured in this study. The non-significant difference in fluoroscopy time in our study could reflect shared reliance on imaging across both systems, variability in surgeon experience, differences in fracture patterns, or X-ray technician experience.

Previous publications on internal locking mechanisms for intramedullary nailing have reported similar, and in some cases more dramatic, results, including a 24.9-minute reduction in surgical duration compared with standard external locking nail systems. Using the same per-minute cost estimates, this would correspond to an estimated savings of approximately $1,361 per surgery, although such cross-study extrapolation should be interpreted with caution[13,14,16]. Other literature suggests that talon-type nails may reduce operative radiation time and that fracture characteristics impact outcomes regardless of fixation type[17]. Although estimated blood loss was not analyzed in our results, prior studies indicate that the fewer incisions required by deployable distal fixation nails correlate with less blood loss, further supporting the clinical value of this nail design[18]. While it was outside the scope of this study to consider implant costs, implant choice can account for a large portion of the overall cost of care provided to a patient. Information about pricing for similar nail systems can be difficult to evaluate, as it is often constrained by proprietary agreements between manufacturers and hospitals, and multiple factors, such as volume or region, can affect the total cost. Even the same implants can be priced differently across healthcare systems[19.]In some cases, implant selection alone has been shown to account for more than 50% in savings, proving to be an opportunity to provide increased value without lowering the quality of care[20.]

This study has several notable limitations. As a retrospective analysis from a single Level II trauma center, it is inherently susceptible to selection bias. With only three surgeons included, the generalizability of the findings is limited. Patient demographics, such as age, sex, and fracture type (e.g., comminuted vs. simple), were not included in the analysis, which could confound operative and fluoroscopy times. Long-term outcomes, including union rates, functional recovery, and complications such as nonunion or implant failure, were beyond the scope of this study but are necessary for a comprehensive evaluation of implant type by the surgeon[21]. Future prospective multicenter studies should incorporate these variables, along with an investigation of overall cost-effectiveness by nail system, to build on the findings of this study.

CONCLUSION

Distal talon fixation systems for intramedullary fixation of humeral fractures were associated with a measurable reduction in operative time, suggesting potential efficiency and cost benefits. As the population continues to age and fracture volume increases, implant

systems that improve surgical efficiency will play a valuable role in delivering high-quality patient care and should be considered by surgeons and systems when choosing an implant type.

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