ORIGINAL ARTICLE

For intramedullary nailing of femoral shaft fractures, talon fixation is helpful to cope with the troublesome distal locking, but conventional distal locking with screws offers a more stable construct: Talon femoral nail versus conventional femoral nail

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ABSTRACT

BACKGROUND: A novel-design femoral nail (FN) with distal talon deployment (Talon-FN) has emerged in the market to cope with problematic distal locking. We aimed to compare the radiological and functional outcomes of the Talon-FN with a conventional FN (Con-FN) for the treatment of femoral shaft fracture (FSFs).

METHODS: This retrospective study included 85 patients (57 men, 28 women; mean age: 46.8±23.9 years) with FSFs (AO types 32-A and B) who were treated with FNs (Talon-FN: 41, Con-FN: 44) during October 2014–2018. Knee injury and Osteoarthritis Outcome Score Physical Function Shortform, Hip injury and Osteoarthritis Outcome Score Physical Function Shortform, Short musculoskeletal function assessment bother and dysfunction indexes were used for functional assessment.

RESULTS: The mean follow-up time was 25.8±6.7 months. The complication rates were 19.6% and 20.5% for Talon-FN and Con-FN, respectively (p=0.92). Malunion was the most common complication for each FN type (Talon-FN: 9.8%, Con-FN: 9.1%). All of the Talon-FN group's malunions were axial (shortening and malrotation) and happened gradually. In contrast, the Con-FN group's malunions were angular (varus and valgus) and caused by initial malreduction. The Talon-FN group's two patients with shortening (4.9%) had AO 32-B type fractures, and the other two with malrotation (4.9%) had AO 32-A3 type fractures, all of four fractures were localized distal to the femoral isthmus. The post-operative functional outcomes were similar between the groups (all p>0.05). The mean operation/fluoroscopy time and the mean blood loss were lower in the Talon-FN group, while the mean union time was shorter in the Con-FN group (all p<0.01). No nonunion was noted in either group. The reoperation rates were similar at approximately 5% (p=0.95).

CONCLUSION: Our study results revealed that the Talon-FN shortens the operation/fluoroscopy time and decreases the intra-operative blood loss with similar functional outcomes. However, the Con-FN seems to offer a more stable construct against axial malunion with a shorter bone union time. The Talon-FN should not be used in FSFs distal to the femoral isthmus with certain types of fractures prone to shortening and malrotation.

Keywords: Complication; conventional femoral nail; distal locking, stabilite; femoral shaft fracture; functional outcome; malunion; radiological outcome; talon femoral nail.

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INTRODUCTION

Femoral shaft fractures (FSFs) are among the most common injuries treated by orthopedic surgeons, with the incidence of FSFs of 10–21/100,000 person-years. Open fractures accounted for nearly 2% of all these fractures.[1,2] FSFs commonly result from high-energy trauma (75% of all FSFs), such as traffic accidents (65% of all FSFs) (i.e., motor vehicle, motorcycle, and pedestrians), fall from heights, and gunshot injuries, and are predominantly recorded among young men. Infrequently, low-energy trauma can also lead to an FSF, such as ground-level falls, bisphosphonate fractures or insufficiency fractures in individuals with osteoporosis, pathological fractures due to bone tumor, and stress fractures from overuse. Women are more likely to sustain an FSF from ground-level falls starting at the age of 60, which can be attributed to osteoporosis.[1,3,4]

An intramedullary nail is a load-sharing device that allows cyclic loading with ambulation with a low risk of implant failure.[5] Alternative treatment options include plates, external fixators, and traction.[6] Furthermore, there are alternative techniques or devices for IMN of FSFs, such as reamed/unreamed nails, flexible/rigid nails, nails with different entry portals (such as lateral trochanteric, trochanteric, and piriformis fossa), and antegrade/retrograde nails. Rigid, reamed antegrade nails are most commonly used for the treatment of FSFs.

Figure 1. (a) Talon DistalFix Femoral Nail System (Orthopedic Designs North America Inc., FL, USA). **(b)** Deployable and retractable talon mechanism.

A new femoral intramedullary nail with a deployable/retractable talon system for easy applicability in the treatment of FSFs has recently emerged in the market. The Talon Distal Fix Femoral Nail (FN) System (Orthopedic Designs North America Inc., FL, USA) is a novel implant (Fig. 1a) that employs an unorthodox technique for distal locking mechanism by deploying talons (Fig. 1b). The promised advantages of deploying talons (instead of free-hand distal locking) are the ease of distal locking with a shorter operation time, fewer incisions, lesser blood loss, and lesser radiation exposure. There is no report yet on the Talon-femoral nail (Talon-FN) in the literature to the best of our knowledge. Therefore, in the present study, we compared the functional and radiological outcomes of Talon-FN with a conventional FN (Con-FN).

MATERIALS AND METHODS

This study was performed under the approval of our institution's ethical review board (Document number: 33216249-903.99-E.14484) and was conducted in compliance with the Declaration of Helsinki. Informed consent was obtained from each participant before the operations. The clinical records of patients who underwent osteosynthesis for FSF fracture during October 2014–2018 were retrospectively reviewed. Patients aged >18 years with the diagnosis of an open (Gustilo Anderson type 1) or closed FSFs (AO 32-A, B) and with a minimum follow-up of 12 months and who underwent fracture fixation using the Talon-FN or through Con-FN (Jiangsu Trauhui Medical Instrument Co., Changzhou, China) were enrolled in our study (Figs. 2 and 3). There were a total of 105 patients with FSFs who were treated with IMNs during this period. The choice of each IMN used during the study period was dependent on the availability of these devices at our university hospital during the intervention period. In our country, orthopedic implants are provided by state hospitals based on the national rules of tender regulated by law. Thus, at no time point was both the IMNs available at the same time during the study period. That is, only one of the IMN was available at a time. Therefore, the decision regarding the choice of either the Talon-FN or the Con-FN was not based on any patient or fracture characteristics. The following were the exclusion criteria: Pathological fractures (n=1), polytrauma fractures (n=11) (All of these polytrauma patients died within the 1st post-operative week.), previous surgery of the ipsilateral limb (n=1), hip or knee osteoarthritis (n=2), and accompanying fracture of ipsilateral or contralateral limb (n=3). Two patients were lost to the follow-up. Thus, a total of 85 patients participated in this study.

Implants and Surgical Technique

The operations were performed on the fracture table with traction under fluoroscopic guidance. Both nails are reamed nails. The Talon-FN is a straight nail without a lateral bend and anatomic anterior bowing compared to the Con-FN. For the Talon-FN, the surgical procedure steps were the same as that of Con-FN, except for the femoral entry point and the talon deployment step. Talon-FN uses the piriformis fossa, whereas the greater trochanter was used for Con-FN's entry point. After inserting the FN, distal talon deployment was performed first with a talon driver. At the end of each surgery, the femur length was measured with the FN set's metal ruler using the contralateral femoral length as a reference. Rotational malalignment was judged by the radiographic profile of the lesser trochanter. The cable technique was used for the determination of the angular malalignment.[7]

Post-operative Follow-up

All patients were allowed weight-bearing as tolerated using a walker on the 1st post-operative day, and they all underwent the same rehabilitation program. The patients were followed up in the outpatient clinic at 4-week intervals until the bone union was achieved, and then they were followed annually. Fracture healing was assessed radiologically. Radiological fracture healing was defined as the presence of a bridging callus on at least 3 of 4 cortices (on the anteroposterior and lateral femur radiographs). The radiographical assessment was performed before and after the operation and also at the time of each follow-up. Nonunion was defined as a failure of fracture healing at the 9th month since surgery.

Data Evaluation

The patients' demographic data (i.e., age and gender), follow-up time, mechanism of injury, type of anesthesia, and the American Society of Anesthesiologists' (ASA) classification were recorded. Perioperative variables, such as the duration of surgery (in minutes), intraoperative blood loss (in milliliters), the length of hospital stay (in days), the time for

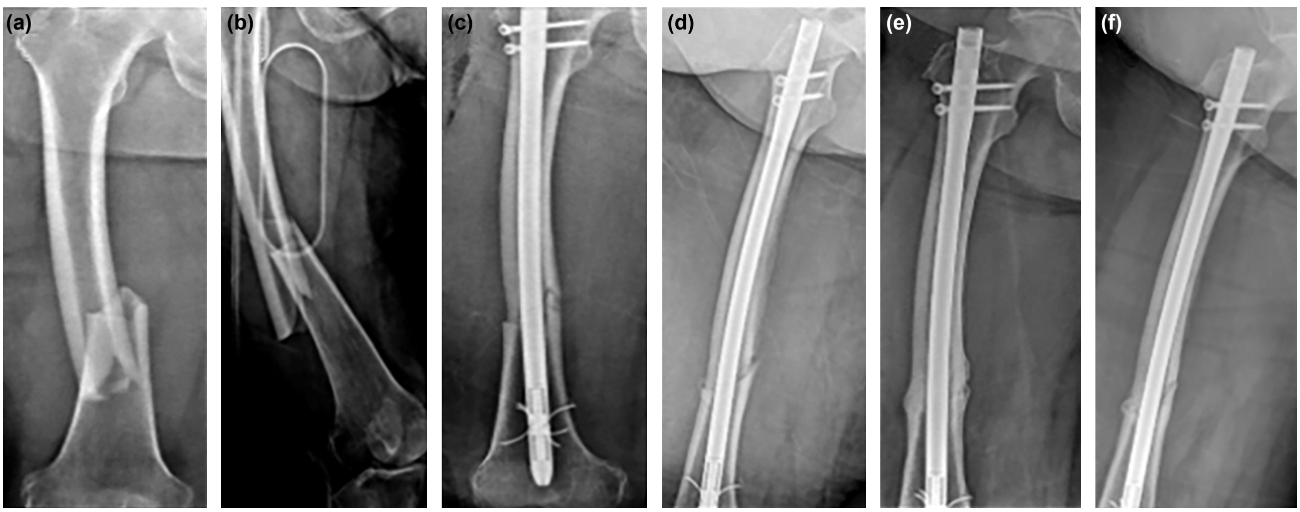

Figure 2. Talon DistalFix Femoral Nail System (Orthopedic Designs North America Inc., FL, USA). **(a, b)** Pre-operative anteroposterior (AP) and lateral (L) views of a femoral shaft fracture. **(c, d)** Early post-operative AP and L views after fixation. **(e, f)** Post-operative 1st-year AP and L views.

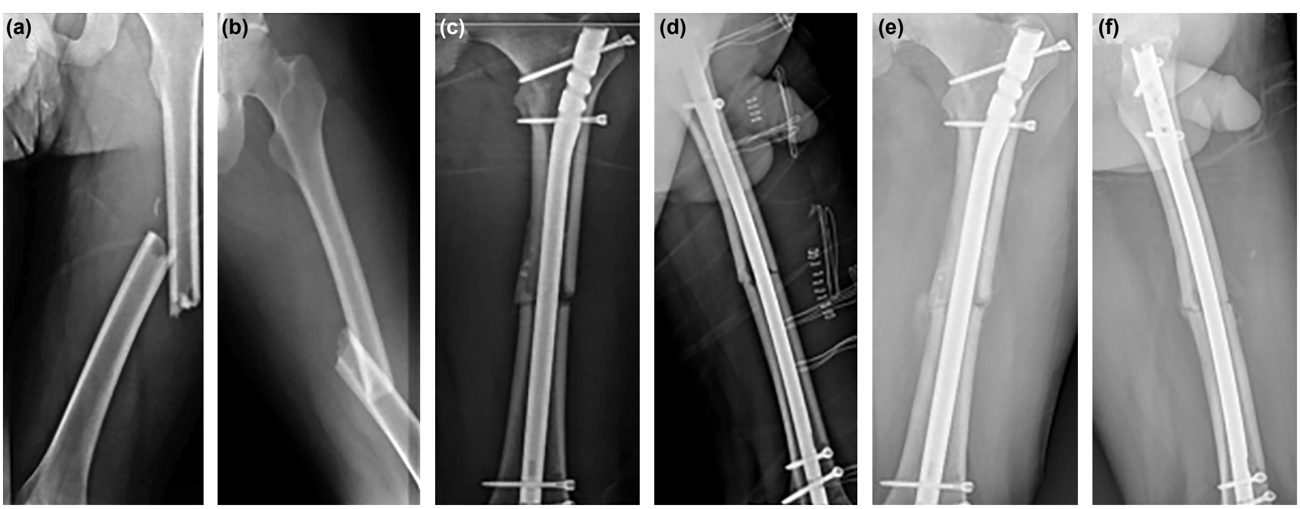

Figure 3. Conventional Femoral Nail (Jiangsu Trauhui Medical Instrument Co., Changzhou, China). **(a, b)** Pre-operative anteroposterior (AP) and lateral (L) views of a femoral shaft fracture. **(c, d)** Early post-operative AP and L views after fixation. **(e, f)** Post-operative 1st-year AP and L views.

achieving bone union (in months), and all complications were recorded.

The Knee Injury and the Osteoarthritis Outcome Score Physical Function Shortform (KOOS-PS), Hip Injury and Osteoarthritis Outcome Score Physical Function Shortform (HOOS-PS), and Short Musculoskeletal Functional Assessment (SMFA) were applied to assess the clinical function.

KOOS-PS and HOOS-PS are 7-item and 5-item measurements of the knee and hip's physical function, respectively. They are intended to elicit people's opinions about the difficulties in their experience concerning the activity due to knee and hip problems. These measurements are scored by summing the responses to the seven items of KOOS-PS or five HOOS-PS items and converting this raw sum to the Rasch-based interval score provided in the user-guide, where 0 points indicate extreme difficulty and 100 points indicate no problems.[8,9]

SMFA is a validated general functional outcome measure used to assess the outcome of various musculoskeletal disorders. The SMFA consists of a dysfunction index, which includes 34 items to evaluate the patient function, and a bothersome index containing 12 items to assess how much patients are bothered by functional issues. This score is a dysfunction measure, wherein 0 indicates the normal function and 100 indicates the maximum dysfunction.[10]

The complications were classified as general, local, and technical. Technical complications consisted of malunion (i.e., angular and axial), fracture due to talon deployment, and broken interlocking screw. General complications consisted of deep venous thrombosis. Local complications consisted of hematoma, superficial wound infection, prolonged wound discharge, and deep infection. Angular (varus/valgus) malunion was defined as >5° angulation. Axial malunion included two subgroups: Shortening and malrotation. Shortening was registered if there was a difference between the measured lengths of the affected and contralateral femurs of >5 mm. Malrotation was determined with the hip rotation test in comparison with the contralateral limb, and it was considered positive when the difference between the rotational movements of the hips was >10°.[7,11] Patients were checked for these deformities during the operations, the early postoperative period, and the latest follow-up.

Statistical Analysis

Statistical analysis was performed using the SPSS 25.0 (SPSS Inc., IBM, NY, USA). Numerical variables were represented as means and standard deviations, and categorical variables were represented as frequencies and percentages. The Kolmogorov–Smirnov test was employed to evaluate the distribution data. Independent sample t-test was used for the comparison of independent quantitative data. A Chi-square test was used to test the differences between the observed frequencies. P<0.05 was considered to be statistically significant.

RESULTS

A total of 85 patients (57 men, 28 women; mean age: 46.8±23.9 years) were enrolled in the study. The mean follow-up time was 25.8±6.7 months. The mean hospitalization time was 2.7±1.1 days. Table 1 displays the major clinical characteristics, such as the demographics, fracture classifications, pre-operative ASA scores, injury mechanisms, and operative data. The mean values of age, body mass index, hospitalization time, ratios of gender, mechanism of injury, fracture type, fracture localization, nail diameter, ASA classification, and the anesthesia type were noted to be similar between the groups. Statistically significant differences between the groups were noted in terms of the mean operation time, mean fluoroscopy time, mean intraoperative blood loss, and mean union time (p<0.01, p<0.01, p<0.01, and p<0.01, respectively). The Talon-FN was recorded to have a shorter mean operation time and fluoroscopy time as well as lesser intraoperative blood loss, although a longer union time.

Table 2 displays all complications, reoperations, and postoperative functional scores. The technical/general/local complications, reoperation rates, and post-operative functional status were found to be similar between the groups. The most common complication observed was malunion (Talon-FN: 9.8% and Con-FN: 9.1%). The rates of patients with at least one complication were similar between the groups (approximately 20%). Two patients in the Talon-FN group required reoperation. One patient underwent nail removal and antibiotic (vancomycin) spacer implantation for a case of deep infection. After the resolution of the infection, the spacer was removed, and bone healing was achieved after re-intramedullary nailing (Fig. 4). Talon deployment caused an (iatrogenic) extension of the fracture line from the fracture site to the talon deployment zone for one patient, and nail exchange was performed with a longer conventional nail. There were two reoperations conducted in the Con-FN group. A broken distal interlocking screw was replaced, and a soft-tissue debridement was performed for hematoma with prolonged wound discharge. Patients with malunion (four patients with angular [varus/valgus] malunion in the Con-FN group, four patients with axial [shortening and malrotation] malunion in the Talon-FN group) were not uncomfortable with their condition in their daily lives; therefore, no revision surgery was performed. Angular deformities of the Con-FN were detected in the early postoperative radiographic assessments and hence missed intraoperatively. Malrotation deformities of the Talon-FN were detected at the latest follow-up. Two patients in the Talon-FN group had gradual shortening deformity (Fig. 5). Patients' angular deformities were between 5° and 10°. Malrotation deformities were between 10° and 20°. Shortening deformities were between 1 and 2 cm. No procurvatum/recurvatum and lengthening deformities were recorded.

Table 1. Main clinical characteristics of the patients

	Talon-FN	Conventional-FN	p	Test
Number of patients	41	44		
Mean age (years), mean±SD	46.5±25.1	47.1±22.9	0.91	T-test
Mean follow-up (months), mean±SD	25.2±5.6	26.2±7.6	0.50	T-test
Gender, n (%)			0.49	Chi-square
Male	29 (70.7)	28 (63.6)		
Female	12 (29.3)	16 (36.4)		
BMI (kg/m^2)	24.5±2.1	24.8±2.1	0.50	T-test
Mechanism of injury, n (%)			0.71	Chi-square
Road traffic accident	24 (58.5)	23 (52.3)		
Domestic fall	15 (36.6)	17 (38.6)		
Fall from height	2 (4.9)	4 (9.1)		
AO/OTA fracture classification, n (%)			0.55	Chi-square
32-A	33 (80.5)	33 (75)		
32-B	8 (19.5)	11 (25)		
32-C	0 (0)	0 (0)		
Fracture localization, n (%)			0.84	Chi-square
Proximal shaft	2 (4.9)	3 (6.8)		
Middle shaft	35 (85.3)	38 (86.4)		
Distal shaft	4 (9.8)	3 (6.8)		
Nail diameter, n (%)			0.61	Chi-square
10 mm	10 (24.4)	14 (31.8)		
11 mm	25 (61)	26 (59.1)		
12 mm	6 (14.6)	4 (9.1)		
Fracture type, n (%)			0.56	Chi-square
Closed fracture	33 (80.5)	39 (88.6)		
Gustilo Anderson type 1 open	8 (19.5)	5 (11.4)		
ASA classification, n (%)			0.82	Chi-square
ASA 1	32 (78)	33 (75)		
ASA 2	6 (14.6)	6 (13.6)		
ASA 3	3 (7.3)	5 (11.4)		
ASA 4	0 (0)	0 (0)		
Type of anesthesia, n (%)			0.66	Chi-square
General	6 (14.6)	8 (18.2)		
Spinal	35 (85.4)	36 (81.8)		
Hospitalization time (days), mean±SD	2.8±1.2	2.6±1.0	0.42	T-test
Mean operation time (min), mean±SD	39.1±3.8	60.1±5.5	<0.01	T-test
Mean fluoroscopy time (s), mean±SD	27.9±4.8	44.7±13.0	<0.01	T-test
Mean intraoperative blood loss (ml), mean±SD	129.6±16.6	190.4±37.6	<0.01	T-test
Mean union time (weeks), mean±SD	22.7±3.6	17.4±2.6	<0.01	T-test
Type of reduction, n (%)			0.85	Chi-square
Open	15 (36.6)	17 (38.7)		
Closed	26 (63.4)	27 (61.3)		

BMI: Body Mass Index; ASA: American Society of Anesthesiologists; AO/OTA: The AO Foundation / Orthopaedic Trauma Association; SD: Standard deviation.

Table 2. Comparison of complications, reasons of reoperation, and functional outcomes

Technical complications	Talon-FN		Con-FN		p	Test
	n	%	n	%		
Malunion	4	9.8	4	9.1	0.92	Chi-square
Angular malunion	0	0	4	9.1		
Varus malunion	0	0	2	4.6		
Valgus malunion	0	0	2	4.6		
Axial malunion	4	9.8	0	0		
Shortening	2	4.9	0	0		
Malrotation	2	4.9	0	0		
Iatrogenic fracture due to talon deployment	1	2.4	0	0		
Broken interlocking screw	0	0	1	2.3		
Total 5	12.2	5	11.4	0.91	Chi-square	
General complications						
DVT	1	2.4	1	2.3	0.96	Chi-square
Local complications						
Superficial infection	1	2.4	2	4.6		
Hematoma	1	2.4	2	4.6		
Prolonged wound discharge	0	0	1	2.3		
Deep infection	1	2.4	0	0		
Total	3	7.3	5	11.4	0.53	Chi-square
Patients with at least one complication	8	19.6	9	20.5	0.92	Chi-square
Reoperation						
Broken interlocking screw replacement	0	0	1	2.3		
Nail removal and debridement with antibiotic spacer implamentation	1	2.4	0	0		
Soft tissue debridement	0	0	1	2.3		
Nail exchange	1	2.4	0	0		
Total	2	4.9	2	4.6	0.95	Chi-square
Postoperative 12th month functional status*						
Mean KOOS-PS Score	84.8±21.6		87.8±16.1		0.46	T-test
Mean HOOS-PS Score	87.6±18.0		85.6±20.3		0.63	T-test
Mean SMFA-Disfunction Index	14.5±13.0		13.3±15.9		0.69	T-test
Mean SMFA-Bother Index	18.8±12.8		17.2±14.5		0.59	T-test

*KOOS-PS: Knee injury and Osteoarthritis Outcome Score Physical Function Shortform; HOOS-PS: Hip injury and Osteoarthritis Outcome Score Physical Function Shortform; SMFA: Short musculoskeletal function assessment.

DISCUSSION

Most of the main clinical characteristics and functional and radiological outcomes were similar between the groups. Differences were noted between the groups in terms of the mean operation time, mean fluoroscopy time, mean intraoperative blood loss, and mean union time. These differences can be attributed to the difference in the design of the implants. The Talon-FN could reduce operation/fluoroscopy time and intraoperative blood loss. However, Con-FN seemed to offer a more stable construct with a shorter bone union time. These findings of the present study were similar to those of Çamurcu et al.[12] on talon tibial nail.

There are a few reports on Talon implants (such as Talon-PFN and Talon tibial nail) in the literature.[12–17] However, the present study is the first to report the outcomes of the Talon-FN. Talon implants rely on talon deployment instead of distal locking for stability purposes. The main disadvantage of conventional distal locking FNs is the difficulty of free-hand insertion of interlocking screws, which leads to increased operation/fluoroscopy time and intraoperative blood loss. To overcome this issue, image intensifier-mounted targeting devices, nail-mounted distal guides, and computer navigation

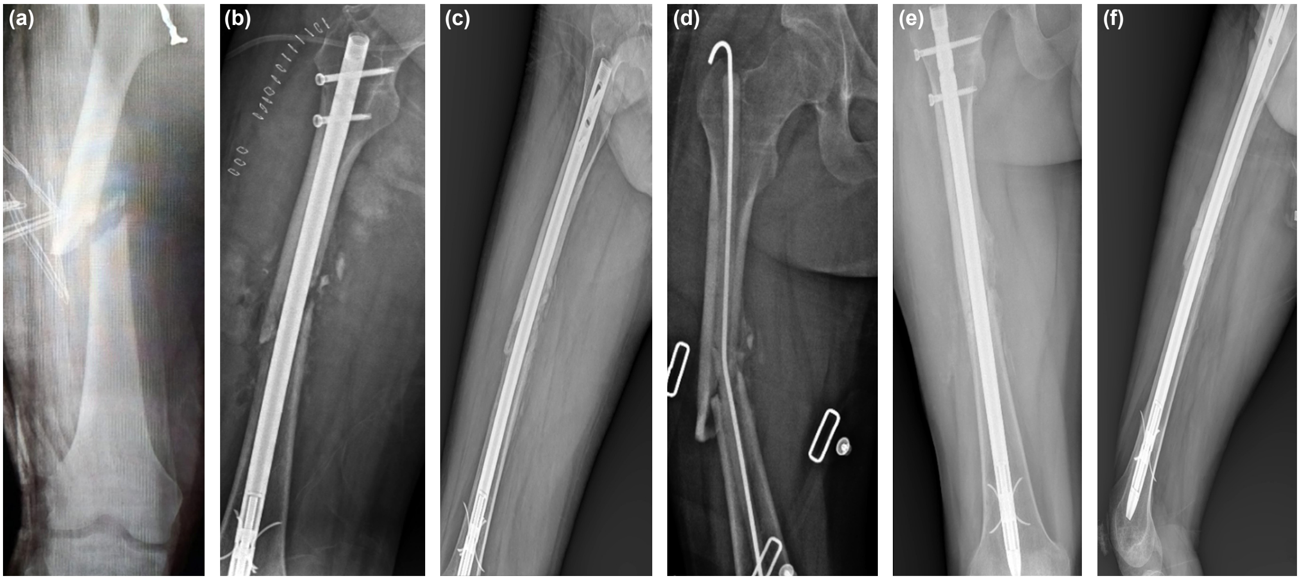

Figure 4. Radiographs demonstrating a successful two-staged revision of the Talon-FN of a patient with deep infection **(a)**, pre-operative anteroposterior (AP) view of the fracture **(b, c)**, early post-operative AP and lateral (L) views after initial fixation **(d)**, early post-operative AP view after Talon-FN removal and antibiotic spacer implantation **(e, f)**, post-operative 1st-year AP and L views after spacer removal and refixation with the Talon-FN.

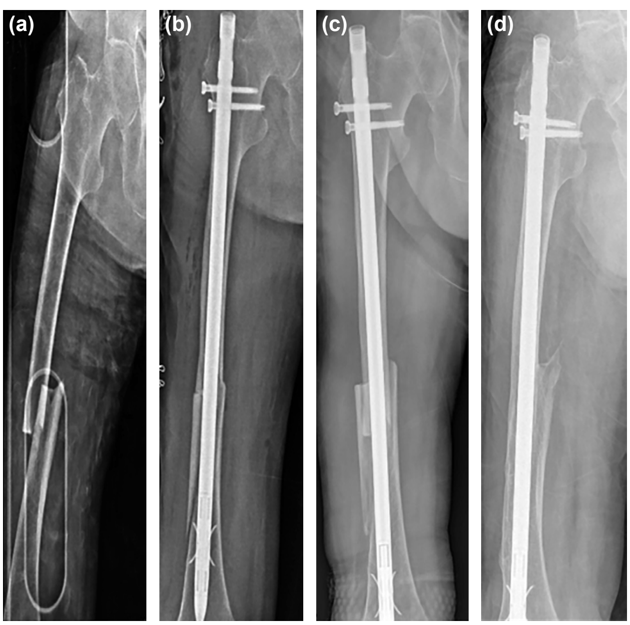

Figure 5. The shortening deformity of a patient with an AO 32-B type femoral fracture implanted with the Talon-FN. **(a)**, pre-operative anteroposterior (AP) view of the fracture. Initial good reduction (**b**, early post-operative AP view) was followed by a gradual 2 cm shortening (**c**, 3 post-operative month AP view) and bone union at the end (**d**, post-operative 1st-year AP view). The Talon-FN seems not to provide enough stability against shortening for the fractures prone to this deformity (AO 32-B and C).

systems were used.[18] Self-locking talon deployment is a new method of distal locking. There are previous reports of self--locking nails. Knothe et al.[19] reported a nail with locking bolts. Two locking bolts were inserted before the nail. Then, the nail with a modified distal end engages these bolts and locks. This system seemed not much different from the distal locking. Another self-locking alternative is the inflatable nail, which is hydraulically inflated with a manual pump to enforce four longitudinal rods against the bone cortex.[20] There is a nail with a 5-flute-shaped geometry.[21] The cross-section of the nail is intended to engage and hold the bone to provide rotational stability. These implants do not provide sufficient torsional qualities as that by distal-interlocking screws, and they have not been widely used.[18]

As the most common complication, the overall malunion rates were similar between the implants (Talon-FN: 9.8% and Con-FN: 9.1%; p=0.92) and were compatible with those reported in the literature. In the literature, the malunion rates of IMN of FSFs have been reported up to 37%.[22–24] This wide range of results can be attributed to various cutoff degrees of malalignment or malunion. In general, it was >5° for angular malalignment as in the present study. Based on this definition, the angular malunion rates (Talon-FN: 0% and Con-FN: 9.1%) were well within this limit. We observed that the Talon-FN centralizes itself in the distal femoral medullary canal by applying talon deployment, which may be the reason for the lower angular malunion rate of the Talon-FN. However, Talon-FN had a higher rate of axial malunion when compared to Con-FN (Talon-FN: 9.8% [shortening 4.9%, malrotation 4.9%] and Con-FN: 0%). We attribute this difference to Talon-FN's stability. We think that the talon deployment did not offer enough stability for compressive and rotational forces, compared to distal interlocking screws, due to less cortical bone purchase if the fracture type and localization were prone to shortening and malrotation. Not surprisingly, the Talon-FN group's two patients with shortening had AO 32-B fractures, and the other two with malrotation had AO 32-A3 type fractures. The common point of these four patients was that the fractures were localized distal to the femoral isthmus. Besides, it would not be wrong to think that Talon-FN fixation may not be sufficient also for AO 32-C type fractures distal to the isthmus. The retrograde use of Talon FN for these types of fractures distal to the femoral isthmus may be the solution for stability issues, as it is a straight nail without a lateral bend and anatomic anterior bowing compared to the conventional nails. This approach requires further studies.

In the literature, the nonunion rate of FSF IMN was up to 12.5%.[25–29] No nonunion was noted in either of the group. Both the implants were observed to have sufficient stability to achieve union. However, the mean bone union time was longer for the Talon-FN group by approximately 5 weeks ($p<0.01$). For FSFs, nonunion is characterized as no fracture healing after 9 months with no radiological development for 3 successive months, whereas delayed union is defined as no fracture healing after 6 months.[30] Mean union times of both implants were within this 6-month limit of normal healing time. This difference between the implants regarding the mean union time could also be attributed to the implants' stability.

There have been reports about residual impairments such as hip abduction and quadriceps weaknesses or gait abnormalities after IMN of FSFs.[31–34] However, other past studies have reported that these issues were resolved after approximately 6 months of operation.[34,35] No residual impairments were noted in this study.

We noted no difference in the hip and knee function or general musculoskeletal function between the implants at the 12th month. Helmy et al.[36] reported SMFA dysfunction and bother indexes as 8 and 9, respectively, after a mean follow-up of nearly 6 years for antegrade IMN of isolated FSFs. Similarly, after a mean follow-up of almost 9 years, El Moumni et al.[37] reported SMFA dysfunction and bother indexes as 15 and 18, respectively. In our study, SMFA dysfunction and bother indexes were approximately 14 and 18 in the 12th month. When the SMFA results in this study were compared with those reported in the literature, the functional scores did not show much improvement after the 1st year of IMN operation. Ricci et al.[38] reported that the mean Harris Hip Score was 77 (indicating a good outcome) with a mean follow-up of 15 months, and the hip range of motion was similar to that of the unaffected side. Daglar et al.[39] evaluated the knee function with a mean follow-up of nearly 4 years and reported good outcomes. In our study, the mean knee (KOOS-PS) and hip (HOOS-PS) functional scores were approximately 85, indicating good knee and hip functional outcomes for both the implant groups, which were comparable to those reported in the literature.

In the light of these findings, we believe that the Talon-FN offers a less-stable fixation than the Con-FN, which may lead to a shortening and rotational deformity and a longer bone-union time. Nevertheless, the fixation is sufficient to achieve bone union. Thus, undoubtedly, the delay in time to the bone union and the probability of axial malunion would have to be a part of the details discussed with the ethical committee to gain approval for further trials. Furthermore, such information would have to be given to the patient in the Talon-FN's informed consent process, discussing the advantages and disadvantages of the implant.

The major limitations of the present study include the retrospective nature and the small sample size. The functional scores used in this study were not specially designed to assess the treatment of FSFs. However, they help evaluate and understand the patients' perspectives. We also applied clinical measurements that were highly dependent on the observer, rather than CT scans, for the rotational malalignment, considering the health burden for the patients. Further prospective randomized controlled trials with larger populations are thus warranted to compare the treatment outcomes of the implants. This study's major strength is that it is the first study to report the new Talon-FN outcomes compared to a Con-FN.

Conclusion

The Talon-FN shortens the operation/fluoroscopy time and decreases the intraoperative blood loss with similar functional outcomes. However, the Con-FN seems to offer a more stable construct with a shorter bone union time. Despite the idea that the talon fixation is useful to cope with the troublesome distal locking, there are still concerns about its stability against compressive and rotational forces and its effect on the bone union time. Therefore, biomechanical studies of this nail design and its comparison with the common FNs with distal locking screws are needed. Until proven otherwise, it should not be used in the FSFs distal to the femoral isthmus, especially for certain types of fractures (AO 32-A3, 32-B, 32-C) prone to shortening and malrotation.

Ethics Committee Approval: This study was approved by the Erzincan Binali Yildirim University Clinical Research Ethics Committee (Date: 20.03.2020, Decision No: 33216249-903.99-E.14484).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Femur şaft kırıklarının intramedüller çivilenmesinde, talon fiksasyonu zahmetli distal kilitlemeyle başa çıkmada yararlıdır, ancak vidalarla konvansiyonel distal kilitleme daha stabil bir yapı sunar: Talon femoral çiviye karşı konvansiyonel femoral çivi

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AMAÇ: Distal kilitlemenin zorluğuyla başa çıkmak için distal talon açılımına sahip yeni tasarımlı bir femoral çivi (Talon-FÇ) piyasaya çıkmıştır. Bu çalışmada, femoral şaft kırıklarının (FŞK) tedavisinde Talon-FÇ'nin radyolojik ve fonksiyonel sonuçlarının konvansiyonel bir femoral çivi (Kon-FÇ) ile karşılaştırılması amaçlandı.

GEREÇ VE YÖNTEM: Bu geriye dönük çalışmaya, Ekim 2014–2018 arası, FŞK (AO tip 32-A ve B) nedeniyle ameliyat edilen 85 hasta (57 erkek, 28 kadın; ortalama yaş: 46.8±23.9 yıl, Talon-FÇ: 41 hasta, Kon-FÇ: 44 hasta) alındı. Fonksiyonel değerlendirme için, Diz Yaralanması ve Osteoartrit Sonuç Skoru Fiziksel Fonksiyon Kısa Formu, Kalça Yaralanması ve Osteoartrit Sonuç Skoru Fiziksel Fonksiyon Kısa Formu, Kısa Kas-İskelet Fonksiyon Değerlendirmesi Rahatsızlık ve Disfonksiyon İndeksleri kullanıldı.

BULGULAR: Ortalama takip süresi 25.8±6.7 aydı. Talon-FÇ ve Kon-FÇ için komplikasyon oranları sırasıyla %19.6 ve %20.5 idi (p=0.92). Malunion, iki çivi tipi için de en yaygın komplikasyondu (Talon-FÇ: %9.8, Kon-FÇ: %9.1). Talon-FÇ grubunun tüm malunionları aksiyeldi (kısalık ve malrotasyon) ve zaman içinde kademeli olarak gerçekleşti. Buna karşılık, Kon-FÇ grubunun tüm malunionları angülerdi (varus ve valgus) ve malredüksiyon kaynaklı idi. Talon-FÇ grubunun kısalığı olan iki hastasında (%4.9) AO 32-B tipi kırık, malrotasyonu olan diğer ikisinde (%4.9) AO 32-A3 tipi kırık vardı ve bu dört kırığın tamamı da femoral istmusun distalinde lokalize idi. Ameliyat sonrası fonksiyonel sonuçlar gruplar arasında benzerdi (tümü p>0.05). Ortalama operasyon/floroskopi süresi ve ortalama kan kaybı Talon-FÇ grubunda daha düşükken, ortalama kaynama süresi Con-FN grubunda daha kısaydı (tümü p<0.01). Her iki grupta da nonunion görülmedi. Reoperasyon oranları iki grupta da yaklaşık %5 olmak üzere benzerdi (p=0.95).

TARTIŞMA: Çalışma sonuçlarımız, Kon-FÇ ile benzer fonksiyonel sonuçlara sahip olan Talon-FÇ'nin ameliyat/floroskopi süresini kısalttığını ve intra-operatif kan kaybını azalttığını ortaya koymuştur. Bununla birlikte, Kon-FÇ, daha kısa bir kemik kaynama süresi ile aksiyel maluniona karşı daha stabil bir yapı sunmaktadır. Talon-FÇ, femoral istmusun distalindeki kısalık ve malrotasyona açık bazı FŞK tiplerinde kullanılmamalıdır.

Anahtar sözcükler: Distal kilitleme; femoral şaft kırığı; fonksiyonel sonuç; komplikasyon; konvansiyonel femoral çivi; malunion; radyolojik sonuç; stabilite; talon femoral çivi.

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