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Comparison of dynamic hip screw and trochanteric fixation nail for intertrochanteric fractures

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Abstract:
It is clinically difficult to identify the best surgical implant for intertrochanteric femur fractures owing to conflicting functional recovery data. A retrospective observational cohort study was conducted on 30 patients over a period of six months to evaluate the functional outcome and post-operative complications of Dynamic Hip Screw (DHS) and Trochanteric Fixation Nail (TFN). Both treatment groups achieved statistically significant, progressive improvements in Harris Hip Scores without significant inter-group differences at all follow-up assessments. Thus, both implants generate similar functional recovery and device use should rather depend on fracture morphology and surgeon experience.

Keywords: Dynamic Hip Screw (DHS), Trochanteric Fixation Nail (TFN), Harris Hip Score (HHS)

Background:
This device, placed outside the marrow, allows controlled impaction and has been shown to promote secondary bone healing through continuous dynamic compression **[1]**. However, the application of it in highly unstable fracture geometries is often associated with the risk of excessive medial collapse and substantial limb shortening **[2]**. That's why the Trochanteric Fixation Nail (TFN) was designed to provide a more biomechanically advantageous load-sharing construct **[3]**. Intramedullary nailing significantly reduces the lever arm by placing the implant in an optimal position closer to the mechanical axis of the femur **[4]**. This structural biomechanical advantage is particularly important in complex fractures where the integrity of the lateral wall is a major concern **[5]**. But the theoretical benefits of intramedullary devices are still heavily debated, without any absolute superiority regarding the global clinical consensus **[6].** The DHS has clear advantages of a well-known simple surgical technique and decreased costs of implants in the health care setting **[7]**. Conversely, the minimally invasive TFN technique generally ensures less intraoperative blood loss and soft tissue damage **[8].** Patterns of post-operative mechanical complications are also different, with standard DHS hardware sometimes demonstrating higher screw cut-out rates in unstable patterns **[9]**. Modern intramedullary devices have a helical blade mechanism designed to significantly enhance purchase in severely osteoporotic cancellous bone **[10]**. An accurate assessment of the functional improvements over time must strictly validate the long-term clinical success of these various interventions **[11]**. Clear understanding of the failure mechanisms of each device **[12]** is required due to the high financial costs of subsequent revision surgeries. Current meta-analyses still provide conflicting evidence and do not prove a clear long-term advantage of one method over the other **[13]**. Therefore, it is of interest to compare the outcomes in the real world, their specific failure mechanisms and their recovery trajectories to inform evidence-based surgical protocols and reduce costly revision surgeries.

Materials and Methods:
A tertiary care hospital conducted an observational retrospective cohort study to compare DHS versus TFN implant functional outcomes along with post-operative complications. The study duration was from 01/01/2021 to 31/12/2022. The analytical sample consisted of 30 adult patients (N = 30) presenting with acute intertrochanteric femur fractures, who were fixed surgically by either DHS (n = 15) or TFN (n = 15). Adult patients with acute closed intertrochanteric fracture were included. The exclusion criteria were intentional pathological fracture, polytrauma patients, individual with previous ipsilateral hip surgery and lost to regular follow up. The demographic data of patients such as age, sex and explicit mode of injury were recorded from clinical data. Post-operative functional recovery was the main outcome measure evaluated carefully with the Harris Hip Score (HHS). The final outcome was definitively graded at 1, 3 and 6 months as Poor (<70), Fair (70-79), Good (80-89) and Excellent (90-100). Another outcome was the strict incidence assessment of operation onset mechanical and biological complication (screw cut-out, implant failure, collapse and non-union).Statistical analysis was carried out using standard statistical packages. Demographic and outcome variables that are continuous were formalized as mean ± standard deviation (SD) and directly compared using independent samples t-tests. Pearson's Chi-square tests were used to compare categorical variables presented as absolute frequencies and percentages. A p-value of <0.05 was established as statistically significant at prospectively alpha level.

Table 1: Comparison of baseline demographic characteristics between treatment groups

Particulars	DHS Group (n=15)	TFN Group (n=15)	p-value
Age (years), Mean ± SD	53.83 ± 16.35	68.80 ± 8.03	1.000
Gender, n (%)			
Male	11 (73.33%)	8 (53.33%)	0.269
Female	4 (26.67%)	7 (46.67%)	0.269

Table 2: Distribution of injury mechanisms by implant type

Particulars	DHS Group (n=15)	TFN Group (n=15)	Total (N=30)
Road Traffic Accident	10 (66.67%)	9 (60.00%)	19 (63.33%)
Fall on ground	4 (26.67%)	5 (33.33%)	9 (30.00%)
Assault	1 (6.67%)	1 (6.67%)	2 (6.67%)

Table 3: Mean postoperative harris hip scores at sequential follow-up intervals

Particulars	DHS (Mean ± SD)	TFN (Mean ± SD)	p-value
1 Month Follow-up	61.82 ± 4.46	62.83 ± 5.20	0.573
2 Month Follow-up	71.65 ± 4.98	72.65 ± 5.52	0.607
3 Month Follow-up	82.12 ± 4.83	82.78 ± 5.31	0.724

Table 4: Temporal progression of categorical functional outcomes based on harris hip scores

Particulars	DHS Group (n=15)	TFN Group (n=15)	p-value
1 Month (Poor <70)	15 (100.00%)	15 (100.00%)	1.000
3 Months			0.454
Fair (70-79)	10 (66.67%)	12 (80.00%)	
Poor (<70)	5 (33.33%)	3 (20.00%)	
6 Months			0.453
Good (80-89)	10 (66.67%)	12 (80.00%)	
Fair (70-79)	5 (33.33%)	3 (20.00%)	

Table 5: Post-operative complications

Particulars	DHS (n=15)	TFN (n=15)	p-value
Screw Cut Out	1 (6.67%)	0 (0.00%)	-
Implant failure	2 (13.33%)	0 (0.00%)	-
Collapse	0 (0.00%)	1 (6.67%)	-
Non union	1 (6.67%)	1 (6.67%)	-
Total Complications	4 (26.67%)	2 (13.33%)	0.654

Results and Discussion:

The aim of this retrospective study was to compare and evaluate functional outcome and explicit complications of DHS and TFN. Among 30 patients, 2 groups were created randomly. **Table 1** shows the baseline demographics, which show a large difference in age. DHS cohort mean age was 53.83 ± 16.35 years whereas TFN cohort mean age was 68.80 ± 8.03 years. In Western countries, low-energy osteoporotic hip fractures are seen to occur much more frequently than in men; this seems to primarily be a disease of post-menopausal elderly women as per Shi *et al.* **[14]** and is therefore different from our findings which show a clear male predominance. The mechanisms for high energy trauma in **Table 2** lend an easy explanation to the local distribution of the population. Road traffic accidents one was responsible for more than 60% of the severe injuries when both implant groups were considered. These specific high-energy mechanisms are often seen in younger males attending busy tertiary trauma centres, consistent with prior work by Patil **[15]** looking at regional demographics. The functional recovery in clinical cohorts was very uniform. **Table 3** presents continuous mean Harris hip scores at any of the post-operative intervals, the indices of absolute functional recovery for both implants did not show any significant difference. According to **Table 4**, time shows these functional outcomes. As expected, all patients had poor functional scores, one month after the operation, which indicates the acute stage after surgery. At the conclusion of the third month, good clinical recovery was observed. At the most recent clinical evaluation performed at 6 months, a final – good functional outcome was achieved by 66.67% of the DHS patients and 80.00% of the TFN patients. According to our findings, both techniques – extramedullary and intramedullary fixation – improve progressively. Notably, one structural implant was not superior to the other regarding the final functional scores. This basic observation is consistent with the literature, which shows that, despite differences in the biomechanics of the modern implant, patient recovery patterns are generally similar provided effective anatomical reduction was achieved during the operation, Parker and Handoll **[16].** This is further supported by recent comparative studies conducted by Singh *et al.* (2023) **[17]** and Kumar *et al.* (2021) **[18]** who similarly showed that both dynamic hip screw and trochanteric/intramedullary nail result in comparable and effective functional outcomes in intertrochanteric femur fracture. A recent meta-analysis of Mustamsir *et al.* **[19]** and Thusoo *et al.* **[20]** showed that there were no differences in functional recovery and overall risk of complications between dynamic hip screw and intramedullary nail in stable fractures. Moreover, a recent meta-analysis of Khorshid *et al.* (2024) **[21]** for more complex unstable fractures, adding a Trochanteric Stabilizing Plate (TSP) to the DHS will provide an essential lateral wall buttress against excessive medialization. Their results showed that DHS with TSP gives functional results which are comparable to that of PFN. Thus, it was concluded that there is no statistically significant difference between the two constructs. Furthermore, even the complication rate of PFN can be more. Post-surgery complications are shown in **Table 5**. The data that was collected was analysed thoroughly and in detail. The DHS group patients experienced marginally more complications compared to those in the TFN group. The extramedullary DHS construct is designed such that fractures should be impacted under controlled conditions because of the rigid barrel. In complicated cases experiencing significant loss of support of the lateral wall, this mechanism may produce excessive unhinged sliding resulting in failure of the hardware. Ahrengart *et al.* **[22]** showed this biomechanical limitation. The intramedullary TFN sits much more proximal to the mechanical axis, thereby theoretically reducing these extreme bending moments. Nonetheless, despite these differences in biomechanics, the assessed absolute difference in complication rate in our patients was not significantly different ($p = 0.654$). Recent morbidity and mortality studies have shown the same risk and survival profile for DHS and more modern intramedullary devices such as the Trochanteric Fixation Nail Advance (TFNA) by López-Hualda *et al.* **[23]**. Nonetheless, intramedullary nail use has some advantages, including significantly less operative blood loss and shorter surgical time; the latter may be critical in unstable per-trochanteric fractures according to Rashid *et al.* **[24].** This finding is very much relevant to today's orthopaedic surgical practice. The comparable statistics and close resemblance in functional outcome and mechanical complication rates may not be a reason for the very expensive intramedullary nail to be used routinely and often indiscriminately for all intertrochanteric fractures. Extramedullary devices such as the DHS remain highly effective, extremely safe and one of the most cost-effective options for stabilizing standard fractures. The key drawbacks acknowledged in the study are certainly the limited local sample size of 30patients and a short clinical follow up which was limited to 6months. Future large multicenter trials will be important to capture late-onset physiological complications. The study above gives a good foundation for the field of orthopaedic trauma for the contemporary surgeon to choose contemporary devices strictly on the basis of clinical fracture morphology with the available health care resources.

Conclusion:

Both the Dynamic Hip Screw and Trochanteric Fixation Nail result in substantial and comparable functional outcome in

individual adults sustaining intertrochanteric femur fractures. Mechanical complications were found to be marginally higher in the DHS cohort, but this clinical difference was statistically insignificant. In the end, both modern-day hardware systems appear to be highly reliable modalities, which indicates that final choice must rely solely on exact fracture morphology and surgeon experience.

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