Open Reduction and Internal Fixation Versus Distal Femoral Replacement for Periprosthetic Distal Femur Fractures: A Systematic Review and Meta-Analysis

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INTRODUCTION:

Periprosthetic distal femur fractures following total knee arthroplasty (TKA) present a clinical challenge. Open reduction and internal fixation (ORIF) and distal femoral replacement (DFR) are both accepted treatment options. While there are risks and benefits to both, there is little known about which is associated with better patient-reported functional outcomes. This study is a systematic review and meta-analysis of studies comparing ORIF to DFR, with a primary outcome of patient-reported outcomes (PROs). Secondary objectives include comparative analysis of functional outcomes and complications.

METHODS:

A comprehensive literature search was conducted in PubMed, Embase, Scopus, and ScienceDirect for manuscripts comparing ORIF and DFR for the treatment of periprosthetic distal femur fractures following the PRISMA statement. Single-arm case series without a comparative group were excluded. Quality analysis was done using the Newcastle-Ottawa Scale. Meta-analyses using the random-effects model were performed to calculate pooled incidence rates, risk ratios (RR), and 95% confidence intervals (CI). Heterogeneity was assessed using I^2 and Cochran's Q-test.

RESULTS:

Thirteen retrospective cohort studies comprising 881 patients (ORIF: 554, DFR: 327) were included. Mean age was 78.3 years; 74% were female. Knee Society Functional Scores were significantly better in ORIF patients vs DFR patients in the two studies reporting this metric (53 vs. 39, p = 0.012; 52 vs 37, p = 0.027). There was no significant difference in Oxford Knee Scores across studies (MD = -0.11, 95% CI: [-1.74, 1.52], p = 0.85). Risk ratios comparing DFR to ORIF showed no difference regarding return to preoperative mobility (RR:0.88, 95% CI: [0.66–1.16], p = 0.35) or achieving unassisted ambulation post-operatively (RR:0.62, 95% CI: [0.26–1.45], p = 0.27). Complication risk ratios for infection (RR:1.10, 95% CI: [0.60–2.01], p = 0.77), reoperation (RR:0.92, 95% CI: [0.63–1.35], p = 0.67), and mortality (RR:0.93, 95% CI: [0.55–1.59], p = 0.80) were not statistically significant, though the incidence rate of reoperation was significantly higher in the ORIF group (ORIF: 12% [8%-15%], DFR: 7% [4%-11%], p = 0.048). The incidence rate of nonunion was 5% (CI: [2%-7%]) for patients treated with ORIF. The weighted mean time to weight-bearing was significantly shorter in the DFR group (2 days) compared to the ORIF group (78 days, p = 0.04)

DISCUSSION AND CONCLUSION:

This meta-analysis suggests that while both ORIF and DFR are comparable treatments for periprosthetic distal femur fractures, ORIF may be associated with superior patient-reported functional outcomes. Notably, ORIF patients reported significantly better Knee Society Functional Scores while other PRO metrics were similar, suggesting a potential discrepancy between lived patient experience and outcome measures. Despite the advantage of immediate weight-bearing with DFR, no long-term functional benefit over ORIF was elicited through the current analysis. Reoperation rates were higher in the ORIF group, possibly due to the salvage nature of DFR or an attempt to preserve native bone in patients ultimately requiring DFR. Interpretation of these results must be approached with caution due to notable limitations. All included studies were retrospective and selection bias likely influenced treatment allocation, as DFR was more commonly performed in older, more comorbid patients in a few included studies. While inconsistently reported, fracture morphology appeared to heavily influence management decisions. These confounding variables may have contributed to differences in outcomes and complication rates. These findings underscore the need for prospective studies with standardized outcome reporting and the routine inclusion of patient-reported outcomes to more fully inform best treatment practices.

ORIF may offer advantages in patient-reported functional outcomes compared to DFR, given the available data. While DFR allows for immediate weight-bearing, this advantage should not imply superior long-term mobility. PRO metrics should continue to be reported as they offer unique insight into patient-experience outcomes relevant to prognosis.

	ORIF				Age	DFR			Age	Outcomes Reported		
Study	Plate	Nail	Male	Female	Mean	DFR	Male	Female	Mean	PRO	Functional	Complications
Leica et al., 2014	39	-	5	34	70.9 (43.0–95.0)	19	5	14	79.2 (50.0–94.0)	No	Yes	Yes
Ruder et al., 2016	35	-	8	27	78 (61-95)	23	4	19	83 (69-94)	No	Yes	Yes
Hoellworth et al., 2017	87	-	-	-	80 ± 9.9	53	-	-	80.1 ± 7.6	No	Yes	Yes
Gan et al., 2018	8	-	0	8	67.9 ± 8.37	7	0	7	76.7 ± 7.78	Yes	Yes	Yes
Darrith et al., 2020	45	5	6	44	71.9 ± 10.6	22	8	14	75.8 ± 8.4	Yes	No	Yes
Tandon et al., 2020	23	17	9	31	74 (65-83)	21	3	18	78 (68-90)	Yes	Yes	Yes
Ang et al., 2021	13	-	*	*	80	14	*	*	85	No	No	Yes
Ross et al., 2021	33	-	4	29	81.3 ± 10.5	27	8	19	78.8 ± 8.3	No	Yes	Yes
De Marco et al., 2022	33	-	3	7	72 (57-68)	4	2	2	76.5 (70-87)	No	Yes	Yes
Fu et al., 2022	12	-	1	11	68.9 ± 11.7	8	1	5	72.7 ± 7.6	Yes	Yes	Yes
Van Heirkeaghe et al., 2023	67	15	**	-	**	39	**	-	**	No	Yes	Yes
Joseph et al., 2023	65	-	32	33	76 (65-91)	58	28	22	78 (65-94)	No	Yes	Yes
Kriechling et al., 2024	61	-	10	71	83 (73-98)	38	5	25	83 (76-87)	No	Yes	Yes
Total	517	37			77.6† ± 9.8	327			79.2† ± 6.2			

Note: *98% of total population was female. **46 females (mean age 76.9) and 26 males (mean age 73.3) in the total population. † Weighted mean age. ‡ age range ± standard deviation

	KSS		KSFS		OKS		Pain	
Study	ORIF	DFR	ORIF	DFR	ORIF	DFR	ORIF	DFR
Gan et al., 2018	-	-	-	-	-	-	5	2
Darrith et al., 2020	85	84	53†	39†	-	-	-	-
Tandon et al., 2020	68	70	-	-	27	28	1.5*	2*
De Marco et al., 2022	-	-	-	-	25.9	33.5	-	-
Fu et al., 2022	80.3	78	51.8†	37†	-	-	-	-
Kriechling et al., 2024	-	-	-	-	-	-	0	1

Note: Significant results are marked with †. Darrith study: p = 0.012; Fu study: p = 0.027. *Indicates pain VAS score average, not number of patients with pain.

Outcome	ORIF	DFR	p
Infection	4% [2%-6%]	4% [1%-7%]	1.00
Reoperation	12% [8%-15%]	7% [4%-11%]	**0.048**
Mortality	14% [9%-20%]	14% [9%-18%]	1.00
Nonunion	5% [2%-7%]	-	-
Ambulatory Without Assistance	24% [15%-34%]	13% [6%-20%]	0.068
Return to Pre-Op Mobility Status	70% [57%-83%]	55% [27%-83%]	0.341

Note: [] 95% Confidence Intervals; Significance set to p < 0.05. Significant values are bolded.