

The Statistical Fragility of Arthroplasty vs. Fixation for Femoral Neck Fractures: A Systematic Review of Randomized Controlled Trials

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INTRODUCTION:

In the setting of femoral neck fractures, hip arthroplasty and internal fixation are considered as treatment interventions depending on the patient's age and fracture characteristics. In this study, we utilized the fragility index (FI), reverse fragility index (rFI), and fragility quotient (FQ) to evaluate the robustness of statistical outcomes reported in randomized controlled trials (RCTs) evaluating arthroplasty vs. fixation in the treatment of femoral neck fractures.

METHODS:

Pubmed, Embase, and MEDLINE were queried from 2010-present for RCTs reporting dichotomous outcomes where intervention arms were stratified as arthroplasty vs. fixation for femoral neck fractures. The FI and rFI were calculated by outcome event reversals until the significance of the outcome was altered for significant and nonsignificant outcomes, respectively. FQ was calculated as the FI divided by the study sample size. Subgroup analysis was performed based on type of arthroplasty vs. fixation and outcome type.

RESULTS:

A total of 985 RCTs were screened with 9 studies included in the analysis comprising 30 total outcomes. The median FI across all outcomes was 5 (IQR 2-10.75) with an associated FQ of .039 (IQR .019-.059). For 14 significant outcomes, the median FI was 4.5 (IQR 2.5-12.5) with an associated FQ of .045 (IQR .02-.098). Across 16 nonsignificant outcomes, the median rFI was 5.5 (IQR 2-8.5) with an associated FQ of .039 (IQR .017-.049). In 11/30 (36.67%) of study outcomes, the number of patients lost to follow up was greater than or equal to the median FI. Four studies evaluated Total Hip Arthroplasty (THA) vs. fixation comprising 15 outcomes with a median FI of 5 (IQR 3-7). Four studies evaluated hemiarthroplasty vs. fixation comprising 10 outcomes with a median FI of 3 (IQR 1-7.5). One study evaluated either THA or HA vs. fixation and reported 5 outcomes with a median FI of 16 (16-18). By outcome type, the median FIs were 4 (IQR 2-11), 6 (IQR 2-6), 16 (IQR 10-16), and 5 (IQR 3.5-6.5) for failure/reoperation, complications/adverse events, mortality, and other, respectively.

DISCUSSION AND CONCLUSION:

The statistical findings reported in RCTs comparing arthroplasty vs. fixation for femoral neck fractures are fragile with reversal of a few outcomes or maintaining follow up being sufficient to alter significance. We recommend the combined reporting of FI and FQ metrics alongside P-values to aid in interpreting the stability of outcomes reported in comparative trials in the orthopaedic trauma literature.

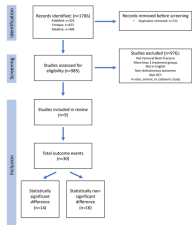


Figure 1. PRISMA flow diagram showing distribution, screening, and inclusion of eligible studies from PubMed, Embase, and Medline

	Events	FI Median (IQR)	rFI Median (IQR)
All RCT Outcomes	30	5 (2-10.75)	5.5 (2.75-8.5)
Significant Outcomes (P<0.05)	14	4.5 (2.5-12.5)	5.5 (2.5-8.5)
Nonsignificant Outcomes (P>0.05)	16	5 (2.5-8.5)	5.5 (2.75-8.5)

Table 1. Fragility data based on trial and outcome characteristics

	Number of Studies	Number of Outcomes	FI Median (IQR)	rFI Median (IQR)
THA vs. Fixation	4	12	5 (3-7)	5.5 (3-8)
Hemiarthroplasty vs. Fixation	4	10	3 (1-7.5)	5.5 (2.5-8.5)
Total arthroplasty vs. Fixation	7	22	4 (3-6.5)	5.5 (2.5-8.5)

Table 2. Subgroup analysis by comparing intervention type

	Events	FI Median (IQR)	rFI Median (IQR)
Failure/reoperation	13	4 (2-11)	5.5 (2.75-8.5)
Complications/adverse events	9	6 (2-6)	5.5 (2.75-8.5)
Mortality	5	16 (10-16)	5.5 (2.75-8.5)
Other	3	5 (3.5-6.5)	5.5 (2.75-8.5)

Table 3. Subgroup analysis by comparing outcome type

	FI	rFI	FI	rFI
Treatment A	0	20	Treatment A	14
Treatment B	5	6	Treatment B	16
				5.5

Figure 2. Demonstration of statistical significance reversal using a 2x2 contingency table with varying fragility index (FI) = 1