Instrumentation Failure in Fassier-Duval Rods: Time to Recognition and Surgical Correction

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INTRODUCTION: Fassier-Duval (FD) rods are widely used in pediatric osteogenesis imperfecta (OI) to manage long bone deformities. Despite their telescoping design, failures such as proximal advancement, backing out, and bent rods remain concerns. This study analyzes time to failure and time to surgical correction across different failure mechanisms.

METHODS: A retrospective review was conducted on 136 pediatric OI patients who underwent 600 femoral and 428 tibial FD rod placements. Data included clinic visit dates, affected bones, and recorded failures. Failure timing was analyzed using two measures: time to failure (days from surgery to clinical identification of failure) and time to surgical correction (days from surgery to intervention). Kruskal-Wallis and Mann-Whitney U tests assessed differences among failure types.

RESULTS: There were 238 femoral instrumentation failures (failure rate 40%) and 187 tibial (failure rate 44%). The most common femoral failure was proximal advancement (51.3%), followed by non-telescoping (37.0%) and bent rods (34.5%) (Table 1). In tibial failures, the most common etiology was non-telescoping (75.9%), followed by bent rods (27.3%) and proximal advancement (26.7%). Bent rods were, on average, recognized after 75 days, which was the earliest of all failure types ($p=0.001$) and had an average time to surgery of 210 days (Table 2). Proximal advancement failures were recognized after an average of 130 days, and led to the quickest interventions, with an average of 150 days to surgery ($p=0.004$). Backing out had a time to failure recognition of 160 days and time to surgery of 250 days. Non-telescoping had the longest time to failure recognition of 380 days ($p<0.001$), and longest time to surgery of 550 days ($p<0.001$). Pairwise comparisons revealed overlapping failure timelines, suggesting concurrent failure mechanisms.

DISCUSSION AND CONCLUSION: Significant differences were found in both time to recognition of failure and time to surgical correction between FD rod failure types, exhibiting distinct failure recognition and correction timelines. Proximal advancements were corrected the fastest, 20 days after failure recognition. Bent rods were recognized the fastest, but treatment was not as urgent. Bent rods often co-occur with other failures, accelerating mechanical decline but not always prompting urgent surgery. Understanding these patterns can improve surgical planning and postoperative monitoring. This study highlights key failure risks and intervention timelines, aiding in optimizing treatment strategies. Further studies are needed to confirm findings and explore interventions to reduce failure rates.

Table 1: Failure types across femoral and tibial OI rods

	Femoral failure (n=238)	Tibial failure (n=187)
Backing Out	76 (31.9%)	29 (15.5%)
Proximal advancement	122 (51.3%)	50 (26.7%)
Bent rod	82 (34.5%)	51 (27.3%)
Non-telescoping	88 (37.0%)	142 (75.9%)

Note: Multiple etiologies may be recorded for one failure; therefore, percentages will not add up to 100%.

Table 2: Average time to recognition and time to surgery for each failure mechanism across both femoral and tibial failures

Failure Mechanism	Average time to failure (days)	Average time to surgery
Bent rods	75	210
Proximal advancement	130	150
Backing out	160	250
Non-telescoping	380	550