Effect of Distal Tibia Epiphyseal Fixation on Telescoping Rod Failure in Children with Osteogenesis Imperfecta

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INTRODUCTION: Fassier Duval (FD) rods are the standard for tibial stabilization in children with Osteogenesis Imperfecta (OI), offering the potential for telescoping of the implant with continued growth to decrease revision surgeries. However, failure to telescope remains common and may reflect technical or anatomical challenges specific to OI and the tibia. Current understanding of factors predisposing to FD rod failure is limited. This study examined how implant positioning and patient age affect telescoping in the tibia.

METHODS: A retrospective analysis on 102 OI patients, who had undergone 428 tibial stabilization surgeries using FD Rods. In patients where both tibias were stabilized, each tibia was analyzed as an independent unit. X-ray images were examined for rod location within the distal physis and failure to telescope. ANOVA and simple linear regression were used for univariate analysis; logistic regression for multivariable analysis.

RESULTS: The overall failure to telescope rate was 46%. Increased age correlated with decreased failure to telescope rates ($p<0.001$) but did not contribute significantly to time to failure ($p=0.997$). On univariate analysis, as seen in Table 1, anterior and posterior placements along the anteroposterior (AP) axis demonstrated higher non-telescoping rates (58% and 56%, respectively) compared to centrally positioned rods (35%, $p<0.001$). Similarly, rods placed laterally along the mediolateral (ML) axis failed to telescope in 70% of cases, compared to 46% in medial and 35% in intermediate positions ($p<0.001$). Despite differences in failure rates, mean time to failure did not significantly differ by AP position ($p=0.212$) or ML position ($p=0.914$). Multivariate analysis, seen in Table 2, shows that non-telescoping failure rate is significantly impacted by age (OR 0.85-0.95, $p<0.001$). Along the ML axis, lateral rod positioning was significantly associated with increased odds of failure compared to intermediate placement (OR 2.71, 95% CI 1.48–5.05, $p=0.001$), while medial positioning showed a nonsignificant trend toward higher failure risk (OR 1.94, 95% CI 0.90–4.18, $p=0.088$). Compared to centrally placed rods along the AP axis, neither anterior (OR 1.19, 95% CI 0.69-2.04, $p=0.521$) nor posterior placements (OR 1.00, 95% CI 0.42-2.31, $p=0.997$) were significantly associated with failure.

DISCUSSION AND CONCLUSION: Failure to telescope was significantly associated with patient age and rod positioning, suggesting that center-center alignment is the ideal position to maximize the longevity of tibial telescoping rods. On multivariate analysis, younger age and deviations in ML positioning were significantly associated with an increased rate of failure. Notably, lateral positioning carried the highest risk, with more than double the odds of failure compared to intermediate placement, while medial positioning showed a non-significant trend towards increased failure. Younger age also correlated with higher failure rates. These findings underscore the importance of intermediate rod placement along the ML plane, particularly in younger patients, to improve telescoping outcomes and reduce mechanical failure.

Table 1: Rate of rod telescoping failure and days to failure based on univariate anterior-posterior (AP) position and medial-lateral (ML) position on post-operative X-ray.

		Non-telescoping	Total	Failure rate	p-value	Days to failure	p-value
AP Position	Anterior	98	168	0.58	p<0.001	677	p=0.212
	Central	71	203	0.35		556	
	Posterior	19	34	0.56		402	
ML position	Lateral	83	118	0.70	p<0.001	561	p=0.914
	Intermediate	95	271	0.35		580	
	Medial	18	39	0.46		487	

Table 2: Multivariable logistic regression: predictors of rod telescoping failure

		OR	CI	p-value
Age		0.90	0.85-0.95	<0.001
AP Position	Central	Reference		
	Anterior	1.19	0.69-2.04	0.521
	Posterior	1.00	0.42-2.31	0.997
ML position	Intermediate	Reference		
	Lateral	2.71	1.48-5.05	0.001
	Medial	1.94	0.90-4.18	0.088