Post-Operative Complications of Intramedullary Nailing for Impending and Pathologic Fractures of the Humerus due to Bone Metastases – A systematic Review of the Literature

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INTRODUCTION: Intramedullary nailing (IMN) is main operative procedure for impending or pathologic fractures of the humerus secondary to metastatic disease. However, literature on post-operative complications and functional outcomes after this procedure is limited. In this population, we sought to assess the (1) early complications, (2) failure rates and mechanisms, and (3) functional outcomes.

METHODS: A systematic review using PubMed, Embase, and Cochrane databases was performed. Studies describing the post-operative outcomes of patients with impending or pathologic fractures of the humerus treated with IMN were included. Implant failure was classified into mechanical and non-mechanical causes. Functional outcomes were assessed using the Musculoskeletal Tumor Society (MSTS) score. Quality assessment was performed using the STROBE checklist. Weighted means and standard deviations (SD) were calculated.

RESULTS: A total of 41 studies comprising 1,431 patients were included (Figure 1). Early complications occurred in 5.5% of patients (SD 5.9%), with 2.8% of patients (SD 8.0%) having systemic complications (Table 1). Early complications included superficial wound complication (1.4%, SD 2.9%) and radial nerve injury (1.3%, SD 2.3%). Overall implant failure rate was 4.9% (SD 5.7%), with tumor progression (non-mechanical) as the most common failure mechanism (1.9%, SD 4.2%). Causes of mechanical failure included structural failure secondary to non-union (1.3%), peri-implant fracture (0.8%), and aseptic screw loosening (1.3%). Mean MSTS score at last follow-up was 79.9% (SD 9.1%) (Table 2).

DISCUSSION AND CONCLUSION:

Humeral IMN was associated with good post-operative functional outcomes and low implant failure rates. Systemic complications were the most common type of early complication and tumor progression was the main cause of implant failure.

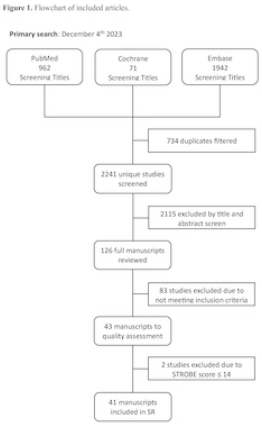

Figure 1. Flowchart of included articles.

Table 1. Early post-operative complications and rate of implant failure.

	Rate (%) [*]
Early complication rate	5.5 ± 5.9
Wound complication	1.4 ± 2.9
Nerve injury	1.3 ± 2.3
Systemic complication	2.8 ± 8.0
Implant failure	4.9 ± 5.7
Mechanical	
Structural failure secondary to non-union	1.3 ± 2.3
Peri-implant fracture	0.8 ± 1.9
Aseptic screw loosening	1.3 ± 2.6
Non-mechanical	
Deep infection	0.4 ± 1.0
Tumor progression	1.9 ± 4.2

[*] Values displayed refer to the pooled mean values and standard deviations.

Table 2. Functional outcome of patients at last follow-up.

Author	n	MSTS (%)
Koob et al. [21]	20	50% [a]
Moura et al. [26]	57	72.6%
Choi et al. [30]	27	92.0%
Laitinen et al. [33]	39	69.0%
Piccoli et al. [34]	51	79.2%
Ofluoglu et al. [14]	20	64.0%
Zhao et al. [46]	16	74.0%
Rovere et al. [50]	7	83.3%
Kobryn et al. [56]	100	89.2%
Pooled analysis	**317**	**79.9 ± 9.1%**

MSTS: Musculoskeletal Tumor Society Score.

[a] This study reported the median MSTS score and was therefore excluded from the pooled analysis.