

Review

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# Enhanced Recovery After Surgery (ERAS) Protocols in Elective Craniotomy: A Systematic Review

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Posted Date: 7 May 2025

doi: 10.20944/preprints202505.0417.v1

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Review

# Enhanced Recovery After Surgery (ERAS) Protocols in Elective Craniotomy: A Systematic Review

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**Abstract: Objective:** To evaluate the efficacy and safety of Enhanced Recovery After Surgery (ERAS) protocols in adult patients undergoing elective craniotomy. **Methods:** A systematic review was conducted following PRISMA guidelines. Randomized controlled trials (RCTs) and observational studies with control groups were included. Databases searched included PubMed, Embase, Scopus, Web of Science, and Cochrane Library up to August 2023. Outcomes assessed were length of stay (LOS), postoperative complications, pain, PONV, and functional recovery. Risk of bias was evaluated using RoB 2 and ROBINS-I tools. **Results:** Ten studies (3 RCTs and 7 observational) were included. ERAS protocols were consistently associated with shorter hospital stays (1–2 days on average), improved postoperative pain control, and reduced PONV. No increase in complication rates was observed. Risk of bias was low in one RCT, moderate in one, and high in another. Observational studies presented moderate to high risk. **Conclusions:** ERAS protocols in elective craniotomy are effective and safe. Standardization and further high-quality multicenter RCTs are recommended.

**Keywords:** Cranial surgery; Enhanced Recovery After Surgery; Length of stay; Neurosurgery; Patient-reported outcomes; Patient satisfaction; Postoperative complications

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## Introduction

Enhanced Recovery After Surgery (ERAS) is a multimodal, evidence-based perioperative care pathway designed to improve recovery outcomes and reduce complications. Although widely validated in abdominal and pelvic surgeries, its application in neurosurgery remains limited. This systematic review aims to assess the impact of ERAS protocols on postoperative outcomes in patients undergoing elective craniotomy.

## Methods

This review followed PRISMA guidelines. The full protocol was prospectively registered in the PROSPERO database (CRD42023480954) X. We searched PubMed, Embase, Scopus, Web of Science, and Cochrane Library for articles published until August 2023. Inclusion criteria were studies involving adult patients (>18 years) undergoing elective craniotomy with implementation of ERAS protocols and a comparison group receiving standard care. We included randomized controlled trials and observational studies with control groups. Risk of bias was assessed using the RoB 2 tool for RCTs and ROBINS-I for observational studies.

Table 1 provides a summary of ERAS (Enhanced Recovery After Surgery) elements implemented in each included study. These elements commonly include components such as postoperative pain control, early mobilization, reduced postoperative nausea and vomiting (PONV), and shorter hospital length of stay (LOS). This table illustrates the variability and core consistency of ERAS strategies across different neurosurgical patient populations.

Study	ERAS Elements
Wang et al. (2022)	Pain control, early mobilization, reduced LOS
Lei Wang et al. (2022)	Pain control, reduced PONV, reduced LOS
Han et al. (2019)	Pain control, reduced LOS, fewer complications
Zaed et al. (2023)	Reduced opioids, early mobilization
Elayat et al. (2021)	Pain control, reduced ICU stay
McLaughlin et al. (2014)	Reduced LOS and ICU stay
Lobatto et al. (2020)	Reduced LOS, fewer complications

Table 2 presents the demographic characteristics of the included studies, detailing the country of origin, study design, total sample size, and the type of neurosurgical population enrolled. This overview aids in assessing the generalizability and applicability of the findings across different health systems and patient settings.

Study	Country	Design	Sample Size	Population
Wang et al. (2022)	China	RCT	151	Glioma
Lei Wang et al. (2022)	China	RCT	151	Elective craniotomy
Han et al. (2019)	China	RCT	84	Aneurysm clipping
Zaed et al. (2023)	Switzerland	Retrospective	19	Elderly with glioblastoma

Elayat et al. (2021)	India	Non-randomized	70		Supratentorial tumors
McLaughlin et al. (2014)	USA	Observational	121		Pituitary/skull base tumors
Lobatto et al. (2020)	Netherlands	Observational	150		Meningioma

## Results

Ten studies met inclusion criteria: 3 RCTs and 7 observational studies.

**Table 1.** Cochrane Data Extraction for RCTs.

Study ID	Country	Design	Sample Size	Population	Intervention	Comparator	Outcomes and Results
Wang et al. (2022)	China	RCT	151	Adults with gliomas	ERAS	Conventional care	Reduced LOS (5 vs 7 days), better pain and mobilization
Lei Wang et al. (2022)	China	RCT	151	Elective craniotomy	ERAS	Standard care	LOS 3 vs 4 days, reduced cost and PONV
Han et al. (2019)	China	RCT	84	Aneurysm clipping	ERAS	Standard care	Reduced LOS, fewer

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**Table 2.** Cochrane Data Extraction for Observational Studies.

Study ID	Country	Design	Sample Size	Population	Intervention	Comparator	Outcome and Results
Zaed et al. (2023)	Switzerland	Retrospective	19	Elderly with glioblastoma	ERAS	Historical cohort	Reduced opioid use, increased mobilization
Elayat et al. (2021)	India	Non-randomized	70	Supratentorial tumor patients	ERAS	Routine care	Reduced ICU stay, better pain control
McLaughlin et al. (2014)	USA	Observational	121	Pituitary/skull base tumors	ERAS	Historical controls	Reduced LOS and ICU stay
Lobatto et al. (2020)	Netherlands	Observational	150	Meningioma patients	ERAS	Standard care	LOS reduced from 7.6 to 3 days, fewer

complica  
tions

## Risk of Bias Assessment

**Table 3.** Risk of Bias in RCTs (RoB 2).

Study	Randomization	Blinding	Overall Risk
Wang et al. (2022)	Low	Low	Low
Lei Wang et al. (2022)	Low	Some concerns	Moderate
Han et al. (2019)	Unclear	High	High

**Table 4.** Risk of Bias in Observational Studies (ROBINS-I).

Study	Confounding	Selection Bias	Overall Risk
Zaed et al. (2023)	Moderate	Moderate	Moderate
Elayat et al. (2021)	Moderate	Moderate	Moderate
McLaughlin et al. (2014)	High	Moderate	High
Lobatto et al. (2020)	Moderate	Low	Moderate

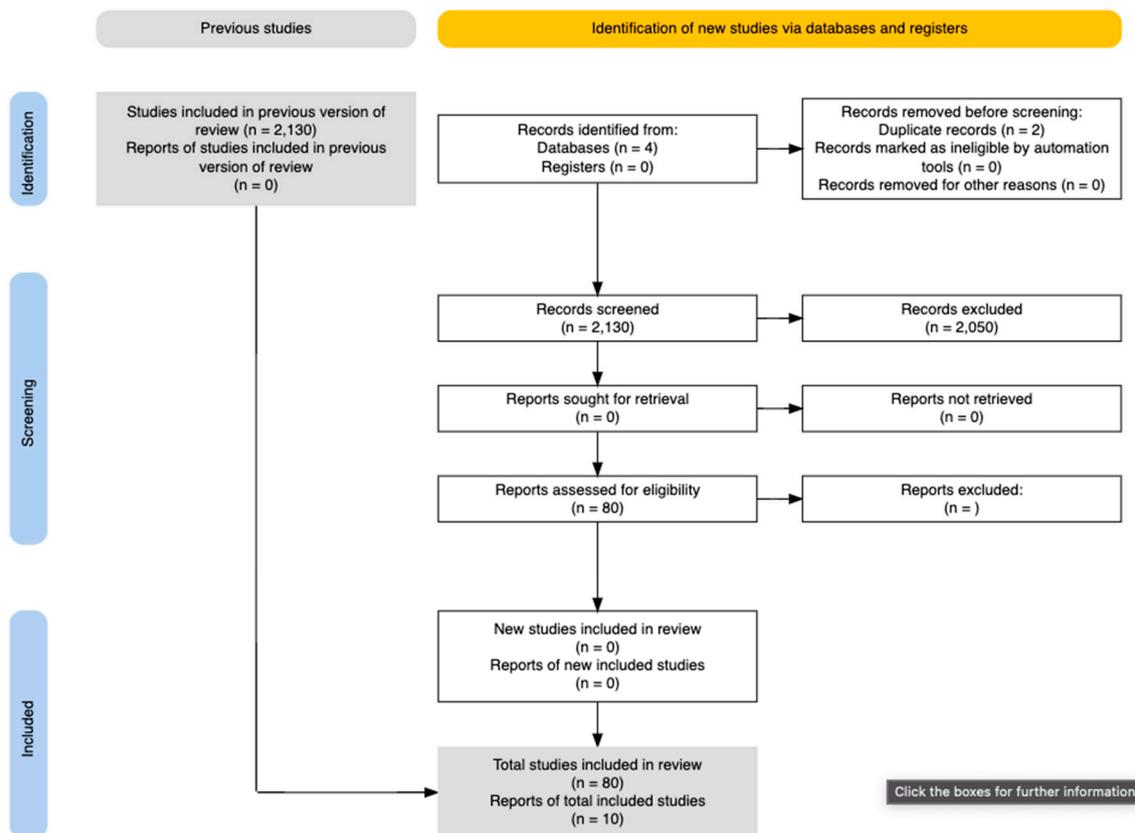
## Conclusions

The use of ERAS protocols in elective craniotomy appears to be safe and beneficial across several outcome domains. While randomized trials offer stronger evidence, observational studies provide valuable real-world insights. There is a need for standardized protocol elements and future high-quality multicenter trials.

## Abbreviations and Acronyms

ERAS: Enhanced Recovery After Surgery  
 LOS: Length of stay  
 PONV: Postoperative nausea and vomiting  
 PRO: Patient-reported outcome  
 RCT: Randomized controlled trial

## Appendix – PRISMA Flowchart



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