

Introduction

Accurate quantification of **intraoperative blood loss** is critical for guiding transfusion and fluid management in craniosynostosis repair. **Estimated blood loss (EBL)**, the most used measure has well-recognized inaccuracies, but its reliability compared to **calculated blood loss (CBL)** in different surgical techniques remains underexplored. This study examined **discrepancies** between **EBL and CBL** in **open** versus **minimally invasive (MIS)** craniosynostosis repairs.

Methods

Retrospective review of **265 craniosynostosis repairs** was conducted, including **186 open and 79 MIS cases**. **EBL** was determined from anesthetic records; **CBL** was determined from hematocrit-based calculations. Paired comparisons between EBL and CBL, relative underestimation percentages, and threshold-based analyses (>50%, >70% and >80% discrepancy) were performed.



Results

Across both surgical approaches, **EBL consistently underestimated CBL**.

Open repairs:

mean **EBL** 173 mL

mean **CBL** 474 mL

Absolute underestimation of **301 mL**

MIS repairs:

mean **EBL** 82 mL

mean **CBL** 310 mL

Absolute underestimation of **228 mL**

MIS repairs showed **higher relative underestimation** of EBL compared to CBL (75% vs 57% $p = 0.0003$).

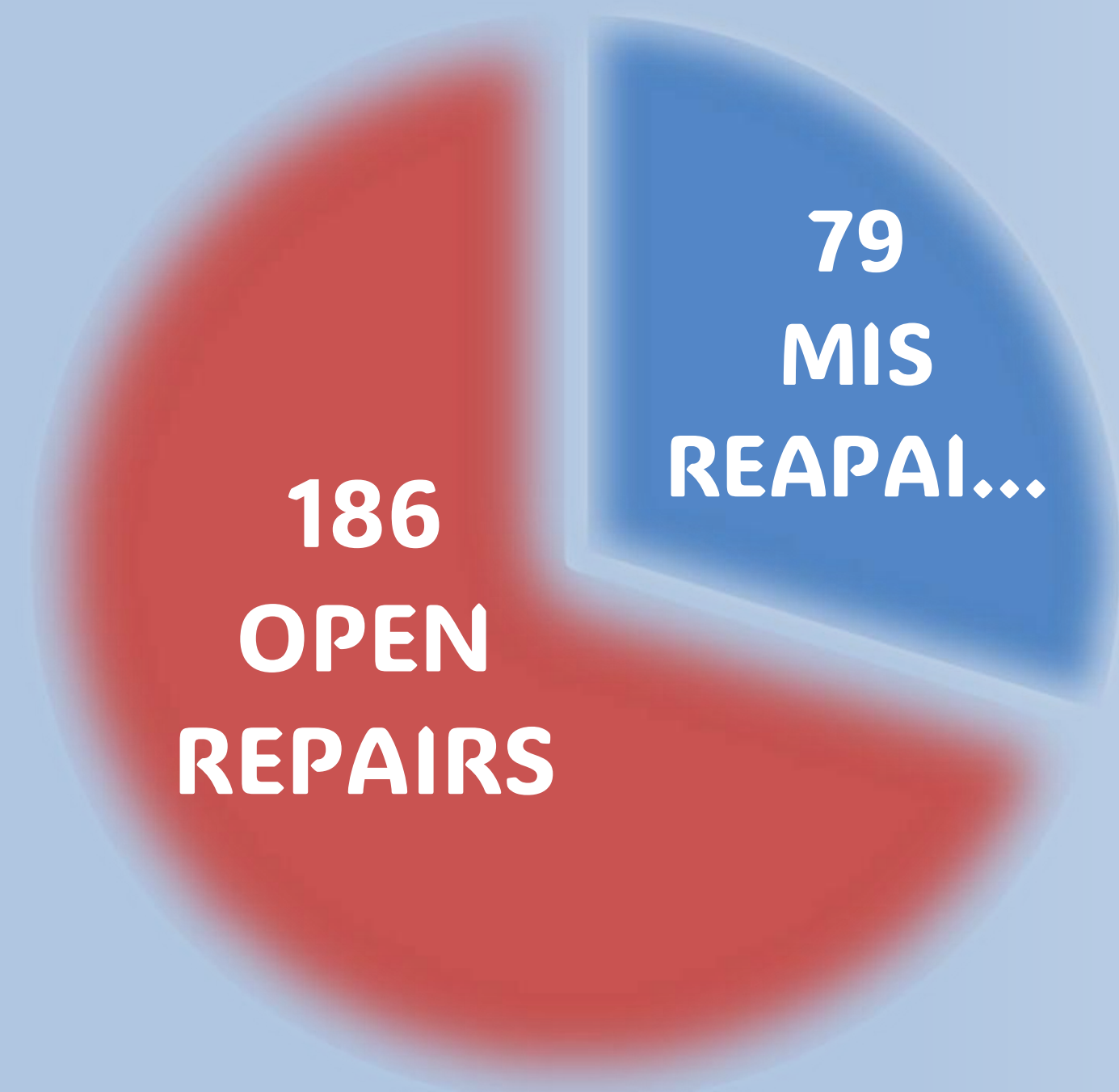
Conclusion

EBL substantially underestimates CBL in craniosynostosis repair. Open exhibit larger absolute underestimation, while **MIS repairs** demonstrate **disproportionately higher** relative underestimation.

These findings emphasize the need for **more reliable intraoperative blood loss assessment** methods. In craniosynostosis repair, deceptively low EBL values may **underestimate transfusion and fluid resuscitation needs essential to patient safety**.

Threshold analyses:

MIS repairs significantly more likely to exceed **50%, 70% and 80%** discrepancy cutoffs (between EBL and CBL) than open repairs (**all $p < 0.01$**).



Implications for Practice and Patient Outcomes

Professional Practice Gap: current reliance on subjective estimated blood loss (EBL) often underestimates true losses and may compromise transfusion and fluid management, particularly across different surgical approaches.

Influence on Patient Outcomes: Recognizing differences in both EBL and CBL by surgical technique may heighten clinician awareness during these surgical procedures and promote the use of objective methods to enhance intraoperative decision-making, optimize transfusion management, and improve patient safety.