

MARVEE TURK, ASLI PEKCAN, RAINA PATEL, MELANIE BAKOVIC, VALERIE MEJIA, MEDHA VALLURUPALLI, WILLIAM MAGEE, PASHA SHAKOORI, MARK URATAT, JEFFREY HAMMOUDEH

Background

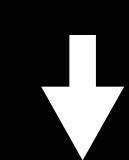
Midface hypoplasia (MFH) is a prevalent and challenging sequela of cleft lip and palate (CLP), attributed to both intrinsic growth restriction and iatrogenic scarring from prior surgical interventions. Orthognathic surgery is required in up to 65% of patients with CLP to reestablish functional occlusion and restore facial harmony. Techniques for maxillary advancement in this context include surgically-assisted maxillary protraction (SAMP), Le Fort I advancement (LF1), and distraction osteogenesis (DO).

Despite technological advances in virtual planning and surgical fixation, skeletal relapse after maxillary advancement is reported as high as 64% among patients with CLP. The clinical and technical factors that predispose patients to relapse and reoperation, however, remain poorly understood. This study aims to identify predictors of skeletal relapse requiring reoperation across different surgical techniques, with an emphasis on procedural thresholds and patient-specific risk factors. By refining surgical risk stratification, we seek to inform individualized treatment planning and mitigate the cumulative burden of care in this high-risk cohort.

Methods

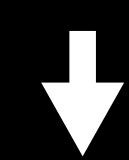
Retrospective review of CLP patients who underwent orthognathic surgery at CHLA between 2005 and 2024 by one of the following techniques:

Surgically-assisted maxillary protraction (SAMP)	Le Fort I advancement (LF1)	Distraction osteogenesis (DO)	Staged DO followed by LF1 (DO+LF1)
--	-----------------------------	-------------------------------	------------------------------------



Primary outcome: re-operation >6 months after orthognathic surgery for recurrence of class III malocclusion not amenable to orthodontic correction

Covariates: basic demographics, cleft phenotype, surgical history, magnitude of maxillary advancement, segmentation, bone grafting



- Analysis
- Multivariable logistic regression to identify independent predictors of reoperation
 - ROC analysis to define optimal threshold for advancement distance predictive of relapse

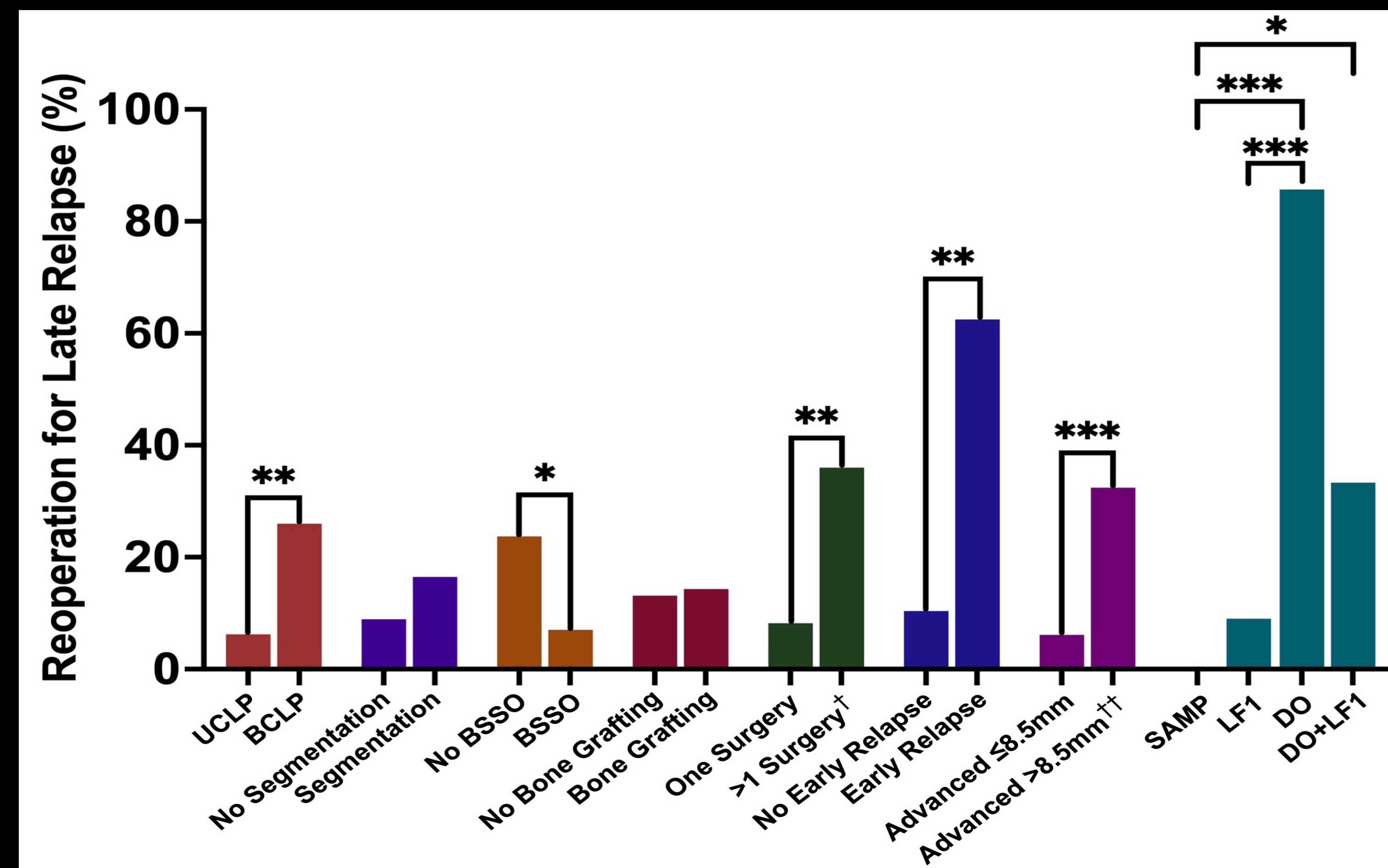


Figure 1. Reoperation Rates Following Orthognathic Surgery for CLP.

Bar graph illustrating the proportion of patients requiring reoperation for late relapse stratified by key variables, including cleft laterality, surgical technique, number of prior maxillary procedures, and extent of sagittal advancement. Asterisks denote statistical significance: $P < 0.05$ (*), $P < 0.01$ (**), $P < 0.001$ (***). † Patients who underwent more than one maxillary surgery involving a Le Fort 1 osteotomy. †† Patients who underwent maxillary advancement of > 8.5 mm.

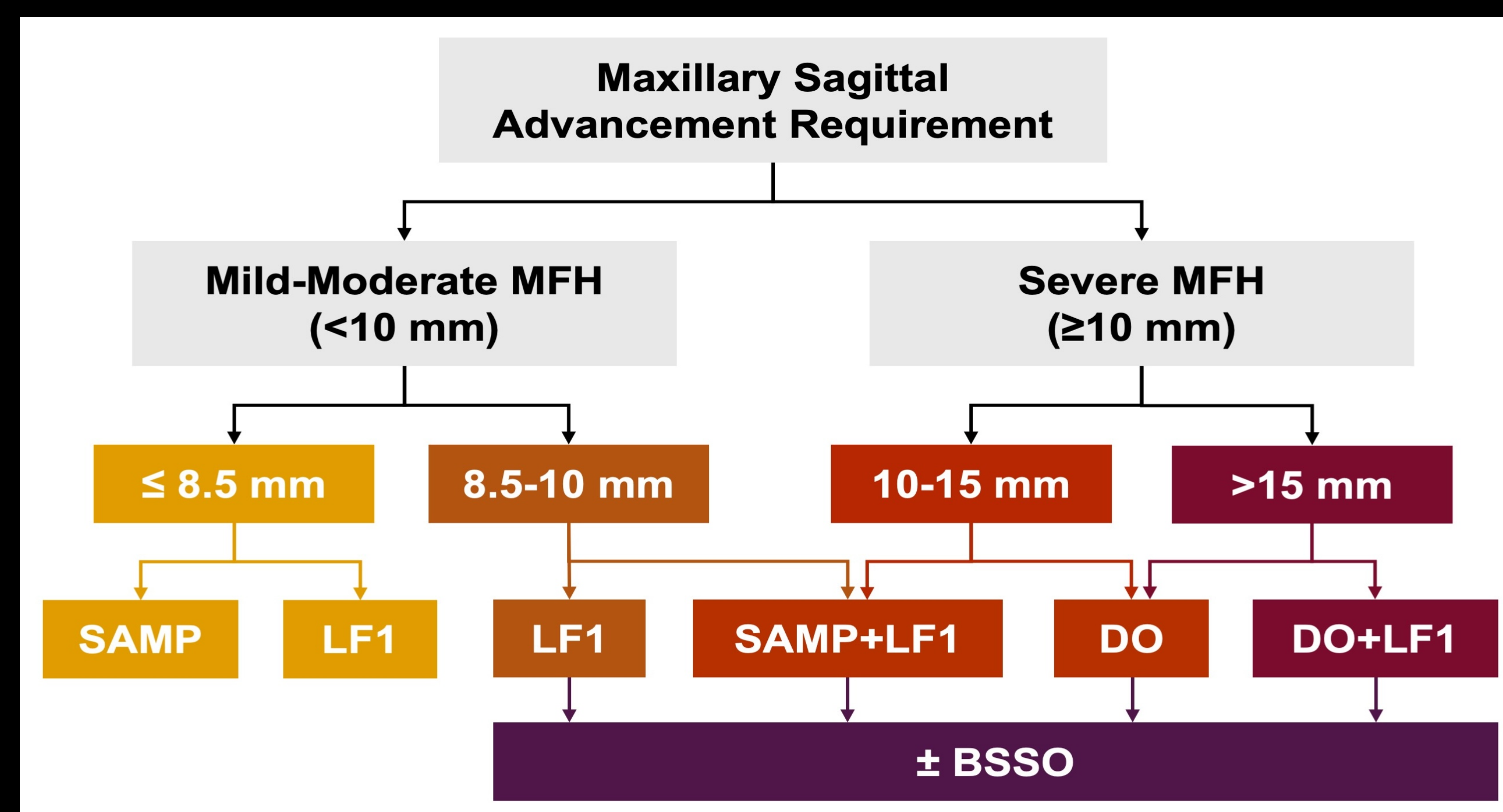


Figure 2. Surgical Planning Algorithm for MFH in CLP.

Proposed treatment algorithm for orthognathic correction of MFH in patients with CLP stratified by severity. The framework guides selection among surgical strategies based on sagittal advancement thresholds and the anticipated risk of skeletal relapse.

Results

Cohort overview

- N=133 patients with CLP underwent orthognathic surgery at CHLA from 2005-24
- Median age at surgery: 18.4 years; median follow-up: 2.1 years
- Cleft laterality: 39.4% bilateral, 60.6% unilateral
- Maxillary advancement surgical techniques:
 - SAMP 12.0%
 - LF1: 76.9%
 - DO: 5.3%
 - DP+LF1: 6.8%

Overall rate of reoperation for recurrent class III malocclusion: 13.5%

- SAMP: 0%
- LF1: 8.9%
- DO: 85.7%
- DO+LF1: 33.3%

Optimal cutoff in maxillary advancement for predicting relapse: 8.5 mm

- Rate of reoperation for advancement > 8.5 mm: 33.3%
- Rate of reoperation for advancement ≤ 8.5 mm: 5.3%
- Sensitivity = 72%, Specificity 75%

Predictors of relapse requiring reoperation

- Bilateral cleft lip and palate: OR 9.4, $p = 0.038$
- Multiple prior maxillary surgeries: OR 4.4, $p = 0.009$
- Early repulse (< 6 weeks post-op): OR 14.4, $p = 0.001$
- Concurrent BSSO: OR = 0.05, $p = 0.027$
- No significant association with palatoplasty technique, prior palatal fistula repair, VPI surgery, SARPE, bone grafting, or ASA class

Conclusions

This two-decade review identifies key predictors of reoperation following orthognathic surgery in patients with CLP, a population uniquely predisposed to skeletal relapse. We report a reoperation rate of 13.5%, with significantly higher incidence among patients undergoing DO or staged DO+LF1 procedures. A sagittal advancement threshold of 8.5 mm emerged as a critical inflection point, above which the likelihood of relapse, and subsequent reoperation, increased over sixfold. Multivariable analysis revealed that bilateral cleft lip and palate and multiple prior maxillary surgeries are strong independent predictors of failure, likely reflecting increased surgical complexity and scarring. In contrast, concurrent BSSO conferred a protective effect, likely by reducing the maxillary advancement required to achieve occlusion. Ultimately, our findings support a risk-adapted, threshold-based algorithm for surgical planning in cleft-related midface hypoplasia.