

## Factors associated with the recurrence of intermittent exotropia and reoperations in the long term

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### ABSTRACT

**Purpose:** To evaluate long-term reoperation risk after bilateral lateral rectus (BLR) recession for intermittent exotropia (IXT) in a paediatric cohort, and to identify the perioperative factors associated with recurrence and reoperation.

**Methods:** A retrospective observational cohort of 258 children with basic or divergence-excess IXT who underwent BLR recession at CUF Cascais Hospital between 2010 and 2020 was analysed. Clinical variables included age, age at surgery, pre- and immediate postoperative deviation angles, preoperative occlusion therapy, orthoptic treatment, binocular function, and initial surgical success (residual deviation <10 prism dioptres with fusion). Bivariate analyses were performed using t-tests or  $\chi^2$  tests, and variables with  $p < 0.10$  were entered into multivariable binary logistic regression to identify the independent predictors of reoperation. Model diagnostics included variance inflation factors (VIF), Hosmer–Lemeshow test, and area under the receiver operating characteristic curve (AUC). Significance was set at  $p < 0.05$ .

**Results:** Reoperation was required in 11% of cases. Failed initial surgery (adjusted OR = 34.7;  $p < 0.001$ ), larger preoperative deviation (adjusted OR per PD = 1.143; 95% CI 1.062–1.231;  $p < 0.001$ ), larger immediate postoperative deviation (adjusted OR per PD = 0.822; 95% CI 0.766–0.881;  $p < 0.001$ ), and older patient age (adjusted OR per year = 1.261; 95% CI 1.032–1.542;  $p = 0.024$ ) were independently associated with reoperation. Orthoptic and occlusion therapies showed non-significant trends.

**Conclusion:** In children undergoing BLR for IXT, initial surgical failure and deviation magnitude (pre- and immediate postoperative) are the strongest predictors of reoperation, with age having the modest additional effect. These findings emphasize precise surgical planning and the need for long-term follow-up.

### ARTICLE HISTORY

Received 21 August 2025  
Accepted 16 January 2026



### KEYWORDS

Intermittent exotropia;  
surgical success;  
recurrence; reoperation;  
paediatric strabismus

## Introduction

Intermittent exotropia (IXT) is one of the most common types of childhood strabismus, with a reported prevalence of approximately 0.5–1.0% in paediatric populations and representing the majority of exotropias in children. It is characterized by an intermittent outward deviation of one or both eyes, typically manifesting at distance fixation and becoming more apparent during fatigue, inattention, or illness.

The pathophysiology of IXT is generally attributed to an imbalance between divergence drive and fusional convergence mechanisms. Children often maintain ocular alignment through adequate fusional reserves; however, these reserves can be insufficient, especially at distance, limiting the ability to maintain fusion under visual stress. Variations in the accommodative convergence to accommodation (AC/A)

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ratio and proximal convergence mechanisms may further contribute to decompensation over time, with episodes becoming more frequent or sustained as children grow, become fatigued, or face increased visual demands.

Clinically, loss of control in IXT can lead to sensory deficits such as suppression, reduced stereopsis, and impaired binocular vision. Visible misalignment may also impact psychosocial well-being, affecting self-esteem and social interactions. Although surgical correction – most commonly bilateral lateral rectus (BLR) recession – is generally effective in realigning the eyes, recurrence and the need for reoperation remain important concerns, particularly over long-term follow-up. Large registry-based studies report 5-year cumulative reoperation rates of around 21%, with other series indicating recurrence rates up to 44% depending on follow-up duration, surgical technique, and patient characteristics [1–4].

Several perioperative factors have been identified as potential predictors of recurrence. Larger preoperative deviation and immediate postoperative Undercorrection are associated with higher recurrence risk, whereas slight overcorrection or minimal residual deviation postoperatively is generally linked to improved long-term stability [5–9]. The choice of surgical technique may also influence outcomes: some studies suggest unilateral recession–resection (RR) may have lower reoperation rates compared with BLR, although other reports find no significant difference when initial deviation and patient age are controlled [10–12]. Age at surgery, preoperative binocular function, and the use of orthoptic or occlusion therapy have also been investigated, but evidence remains inconclusive [13–15].

Despite extensive literature, many previous studies are limited by heterogeneous inclusion criteria, varying surgical techniques, or relatively short follow-up periods. Few studies have systematically analysed perioperative clinical, sensory, and motor factors associated with reoperation at long-term follow-up [16,17].

This study addresses these gaps by examining a large, homogeneous cohort of 258 children with basic-type intermittent exotropia who underwent BLR recession at a single tertiary institution, with a minimum follow-up of five years. The primary objectives are to determine the cumulative risk of reoperation over five years and to identify clinical, sensory and surgical factors associated with the need for reoperation, providing a clearer understanding of long-term surgical outcomes in IXT.

## Methods

### *Study design and population*

This was a retrospective observational cohort study including 258 children who underwent BLR recession for basic or divergence-excess intermittent exotropia between 2010 and 2020 at CUF Cascais Hospital (Lisbon, Portugal). Baseline was defined as the date of the first BLR procedure. Patients were followed for up to 5 years postoperatively.

All operations were performed at the Ophthalmology Unit, CUF Cascais Hospital. Surgeries were carried out by same surgical team (principal surgeon, adjutant surgeon and anaesthesiologist) –experienced surgeons with expertise in paediatric strabismus. All surgeons adhered to a standardized institutional protocol for BLR recession – Surgical dosage for BLR recession was determined according to the Parks nomogram.

Only primary bilateral lateral rectus (BLR) recessions were included in this cohort – we use only this technique because it is more favourable for binocular vision and not produce lateral incomitances. Patients undergoing unilateral recess-resect procedures, medial rectus resections, or other horizontal muscle surgeries were excluded. Reoperations included any subsequent horizontal muscle surgery (including RR or MR resections) performed for residual or recurrent exotropia.

Orthoptic therapy was offered postoperatively to patients with suboptimal fusion or residual divergence. The standard regimen at our centre comprised: Office-based sessions (30–45 min) every 1–2 weeks for 6–12 weeks focusing on fusional convergence (synoptophore and vectogram exercises) and accommodative facility training and Home-based exercises (pencil push-ups and convergence brock string or home vectogram practice) prescribed daily for 10–15 min, with recommended frequency of 5–7 days/week.

Because of the compliance in therapy, in statistical analysis only included patients who are doing therapy program with convenience (good adherence in the office and home therapy).

### **Data collection**

Clinical data were obtained from electronic medical records. Evaluations included clinical history, visual acuity, ocular motility, and binocular sensory testing using a synoptophore. These tests were executed by same orthoptist and with guidelines of PEDIG GROUP and American Academy of Pediatric Ophthalmology and strabismus. After surgery, some patients underwent orthoptic therapy aimed at improving fusion and convergence. Preoperative alternate occlusion was used as an anti-suppression exercise. In patients with alternating deviation and no marked fixation preference, alternate occlusion was applied for 1 h per day, whereas in patients with unilateral deviation and strong fixation preference, occlusion of the dominant eye was performed for 1 h per day. Postoperative orthoptic therapy included in-office exercises performed at the treatment room and using a synoptophore, aimed at strengthening fusion and convergence, complemented by home-based exercises to reinforce these skills.

### **Variables analysed**

The study analysed perioperative variables potentially associated with reoperation, including: preoperative occlusion therapy, preoperative deviation angle (prism diopters, PD), postoperative deviation angle (PD) – immediate postoperative deviation was defined as the ocular deviation measured at the first postoperative visit, performed within 24–72h after surgery, prior to initiation of orthoptic therapy, binocular function (present/absent), surgical success (initial surgical success was defined as ocular alignment within <10 prism diopters of eso- or exodeviation with demonstrable fusion, assessed at the first postoperative visit (within 1 week after surgery). Surgical failure was defined as a residual deviation  $\geq 10$  prism diopters and/or absence of fusion at this same time point), orthoptic treatment (yes/no), patient age at surgery, and sex.

Reoperation was defined as any secondary horizontal muscle surgery performed for residual or recurrent exotropia.

### **Statistical analysis**

All analyses were performed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean  $\pm$  standard deviation (SD), and categorical variables as counts and percentages.

For description on sample, we did a univariate analysis. Second, bivariate comparisons were conducted using Student's t-test or Mann–Whitney U test for continuous variables, and  $\chi^2$  or Fisher's exact test for categorical variables. Variables with  $p < 0.10$  in bivariate analyses and those considered clinically relevant were entered into multivariable binary logistic regression models to identify independent predictors of reoperation (outcome: reoperation yes/no).

Backward stepwise elimination (entry  $p = 0.05$ , removal  $p = 0.10$ ) was used to build the final model. Multicollinearity was assessed with variance inflation factors (VIF  $> 5$  indicating collinearity). Model fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test, and discrimination was assessed with the area under the receiver operating characteristic (ROC) curve (AUC).

Two-sided  $p$ -values  $< 0.05$  were considered statistically significant.

### **Ethical consideration**

The study protocol was approved by the Ethics Comité of the CUF Health Group (approval number 2024/808) and conducted in accordance with the Declaration of Helsinki. Given its retrospective design, the Ethics Committee waived the requirement for additional informed consent. However, written informed consent for data use in research and education was obtained from parents or legal guardians at the time of surgery. Assent from children was generally not obtained due to their young age.

All data were collected retrospectively from existing clinical records and pseudo-anonymized prior to analysis to ensure participant privacy. No identifiable personal data were used, and all procedures adhered strictly to institutional and national guidelines for confidentiality and data protection. Every step of the study respected the ethical standards required for clinical research.

## Results

### Cohort characteristics

A total of 258 children who underwent bilateral lateral rectus (BLR) recession for intermittent exotropia were included. The mean age at baseline surgery was  $8.7 \pm 4.8$  years (min 8 yo and max 18 yo). Overall, 11% ( $n=29$ ) of patients required reoperation during the five-year follow-up period. Among female patients, 13.3% required reoperation, compared with 7.6% of male patients; however, this difference was not statistically significant ( $p=0.154$ ). Baseline demographic and clinical characteristics by reoperation status are presented in Table 2.

### Preoperative and postoperative alignment

Before surgery, the mean angle of exodeviation was significantly larger in patients who later required reoperation compared to those who did not ( $38.5 \pm 7.6$  prism diopters [PD] vs.  $30.9 \pm 7.0$  PD;  $p < 0.001$ ). At the first postoperative assessment, residual deviation was also significantly greater among patients who subsequently underwent reoperation ( $12.3 \pm 7.7$  PD vs.  $2.5 \pm 5.8$  PD;  $p < 0.001$ ).

Surgical failure, defined as residual deviation  $\geq 10$  PD or loss of fusion, was strongly associated with reoperation. Seventy per cent of patients with initial surgical failure required a second procedure, compared with only 6.3% of those with successful alignment ( $p < 0.001$ ).

### Preoperative sensory and therapeutic factors

Preoperative occlusion therapy was performed in 13.0% of patients who later required reoperation and in 2.3% of those who did not. Orthoptic therapy was conducted postoperatively in 9.4% of reoperated patients and 12.4% of non-reoperated patients, showing no statistically significant difference ( $p=0.456$ ). Absence of preoperative binocular function was observed in 33.3% of reoperated cases compared to 10.7% of non-reoperated cases; this difference did not reach significance ( $p=0.109$ ).

### Univariate analysis

In univariate logistic regression analyses, several variables showed significant associations with reoperation (Table 1).

Surgical success was the strongest predictor, with a markedly reduced likelihood of reoperation (OR = 0.029; 95% CI 0.010–0.086;  $p < 0.001$ ).

Larger preoperative deviation increased the probability of reoperation (OR per PD = 1.151; 95% CI 1.068–1.241;  $p < 0.001$ ).

Smaller postoperative deviation was protective (OR per PD = 0.797; 95% CI 0.735–0.865;  $p < 0.001$ ).

Older age at the time of primary surgery was associated with a higher risk of reoperation (OR per year = 1.261;  $p=0.024$ ), independent of follow-up duration, which was uniform across the cohort

Preoperative occlusion therapy ( $p=0.075$ ) and age at surgery ( $p=0.055$ ) demonstrated near-significant trends but did not meet the pre-defined significance threshold.

No statistically significant associations were found for sex, orthoptic therapy, or binocular function.

**Table 1.** Parks nomogram for exotropia surgery.

Deviation (PD)	BLRc	LRc+MRs (R&R)
15	4.0	4.0+3.0
20	5.0	5.0+4.0
25	6.0	6.0+4.0
30	7.0	7.0+5.5
35	7.5	7.5+5.5
40	8.0	8.0+5.5
45	8.5	8.5+6.0
50	9.0	9.0+6.5
60	9.0+7.0	—

## Multivariable analysis

Variables with  $p < 0.10$  in univariate analysis were included in a multivariable logistic regression model to identify the independent predictors of reoperation (Table 3). After adjustment, three variables remained statistically significant:

Preoperative deviation: larger angles increased the risk of reoperation (adjusted OR per PD = 1.143; 95% CI 1.062–1.231;  $p < 0.001$ ).

Immediate postoperative deviation: smaller deviations were protective (adjusted OR per PD = 0.822; 95% CI 0.766–0.881;  $p < 0.001$ ).

Age: older age independently predicted a higher risk of reoperation (adjusted OR per year = 1.261; 95% CI 1.032–1.542;  $p = 0.024$ ).

Surgical success, orthoptic therapy, and occlusion treatment were not significant in the final adjusted model. No evidence of multicollinearity was found among predictors (maximum VIF = 1.43). The Hosmer–Lemeshow goodness-of-fit test indicated adequate model calibration ( $p = 0.68$ ), and the model demonstrated strong discrimination (AUC = 0.87; 95% CI 0.81–0.92).

## Summary

These findings indicate that greater preoperative deviation, larger immediate postoperative deviation, and older patient age were independently associated with the need for reoperation. Other variables, including sex, binocular function, and orthoptic or occlusion therapy, did not show statistically significant effects.

A Kaplan–Meier survival curve was constructed to evaluate the cumulative probability of remaining free from reoperation over time (Table 4). The estimated 5-year reoperation-free survival rate was 88.9% (95% CI: 84.7–93.1%).

**Table 2.** Baseline characteristics and univariate analysis of factors associated with reoperation ( $n = 258$ ).

Variable	No Reoperation ( $n = 229$ )	Reoperation ( $n = 29$ )	OR (95% CI)	$p$ -value
<b>Sex</b>				
Female Sex (ref)	144 (86,7%)	22 (13,3%)	0.536 (0.228–1.260)	0.154
Male Sex	85(92,4%)	7(7,6%)		
Age at surgery (years)	8.3 ± 4.6	9.6 ± 5.2	1.066 (0.998–1.138)	0.055†
Preoperative deviation (PD)	30.9 ± 7.0	38.5 ± 7.6	1.151 (1.068–1.241)	<0.001***
Immediate postoperative deviation (PD)	2.5 ± 5.8	12.3 ± 7.7	0.797 (0.735–0.865)	<0.001***
<b>Surgical success</b>				
Yes	223 (93,%)	14 (70%)	0.029 (0.010–0.086)	<0.001***
No	6 (30%)	15 (6,3%)		
<b>Preoperative occlusion therapy</b>				
No (Ref.)	42 (97,7%)	1 (23,3)	6.289 (0.801–49.359)	0.075†
Yes	187 (87%)	28 (13,3%)		
<b>Postoperative orthoptic therapy</b>				
No (Ref.)	141 (86,7%)	20 (12,4%)	0.732 (0.252–2.127)	0.568
Yes	87 (90,6%)	9 (9,4%)		
<b>Binocular function</b>				
Present(Ref.)	225 (87,3%)	27 (10,3%)	4.090 (0.745–22.463)	0.109
Absent	4 (66,7%)	2 (33,3%)		

Abbreviations: PD=prism diopters; OR=odds ratio; CI=confidence interval. Notes: continuous variables are expressed as mean ± SD; categorical as %.  $p < 0.05$  considered statistically significant.  $p < 0.10$  (†) indicates a trend toward significance;  $p < 0.001$  (\*\*\*); variables with  $p < 0.10$  were entered into the multivariable regression model.

**Table 3.** Multivariable binary logistic regression analysis of independent predictors of reoperation.

Variable	Adjusted OR	95% CI	$p$ -value
Preoperative deviation (per PD)	1.143	1.062–1.231	<0.001***
Immediate postoperative deviation (per PD)	0.822	0.766–0.881	<0.001***
Surgical success	0.275	0.063–1.198	0.084†
Preoperative occlusion therapy	2.914	0.553–15.362	0.207
Orthoptic therapy	0.879	0.321–2.410	0.806

Model statistics: Hosmer–Lemeshow test:  $p = 0.68$  (good fit). AUC = 0.87 (95% CI 0.81–0.92), indicating excellent discrimination. Maximum VIF = 1.43 (no multicollinearity).  $p < 0.05$  significant;  $p < 0.10$ † trend.

**Table 4.** Kaplan–Meier estimates for reoperation-free survival after bilateral lateral rectus recession ( $n=258$ ).

Follow-up time (years)	No. at risk	No. of events (reoperations)	Cumulative survival (%)	95% CI
0	258	–	100.0	–
1	250	9	96.5	93.7–99.3
2	238	6	94.2	90.5–97.9
3	220	8	91.1	86.7–95.5
4	207	4	89.6	85.0–94.2
5	190	2	<b>88.9</b>	<b>84.7–93.1</b>

Notes: Although all patients had a minimum clinical follow-up of five years, the Kaplan–Meier analysis accounts for censoring related to the occurrence of reoperation events, which explains the progressive reduction in the number of patients at risk over time.

Most reoperations occurred within the first three years following surgery, with the survival curve plateauing thereafter, indicating relative stability in alignment among patients who maintained satisfactory postoperative control beyond this period.

The log-rank test demonstrated significant differences in reoperation-free survival between patients with successful initial alignment and those with early surgical failure ( $p<0.001$ ).

These findings reinforce that the first postoperative years represent the critical period for identifying early recurrence and implementing preventive or rehabilitative interventions.

Reoperation defined as any secondary horizontal muscle surgery for residual or recurrent exotropia. Log-rank test:  $p<0.001$  comparing surgical success vs. failure after initial operation. CI=confidence interval.

## Discussion

This retrospective study analysed long-term outcomes after bilateral lateral rectus (BLR) recession for intermittent exotropia (IXT) in a paediatric population. The results demonstrate that larger preoperative deviation, greater immediate postoperative deviation, and older patient age are independently associated with a higher risk of reoperation. These findings reinforce previous literature highlighting that alignment accuracy during the early postoperative period is one of the strongest determinants of long-term surgical stability [18–22].

### *Influence of pre- and postoperative deviation*

The magnitude of preoperative deviation has consistently been linked to surgical prognosis. In this study, each additional prism dioptre increased the odds of reoperation by approximately 14%. Similar associations have been described in previous studies, where larger angles correlated with reduced fusion potential and higher recurrence rates [10,20, 23,24]. The strong effect of immediate postoperative deviation further emphasizes the importance of achieving slight overcorrection or minimal residual deviation in the early postoperative phase to reduce the likelihood of drift toward recurrence [8,15,25].

Postoperative alignment within  $\pm 10$  PD has traditionally been used as the definition of surgical success. Our findings confirm that small residual deviations are protective against reoperation. These results are in line with recent meta-analyses showing that early Undercorrection strongly predicts long-term recurrence, while mild overcorrection is associated with better stability [26–28].

### *Role of age and sensory factors*

Older patient age was also independently associated with reoperation. This may be related to the gradual decline in sensory plasticity and fusional reserve with age, limiting the ability to maintain alignment after surgery [14,29,30]. However, other studies have reported no significant correlation between age and recurrence [30], suggesting that age may act as a surrogate for other underlying biological or behavioural factors influencing postoperative control.

Preoperative occlusion and orthoptic therapies showed trends toward significance but did not reach statistical thresholds. This may reflect both small subgroup sizes and heterogeneity in therapeutic regimens. Although orthoptic therapy aims to improve convergence and sensory fusion, its impact on

surgical outcomes remains uncertain [31–33]. A prospective, standardized approach could clarify whether such interventions modify long-term stability.

### **Comparison with previous literature**

The 11% reoperation rate observed in our study aligns with the lower range of values reported in the literature, which varies between 10% and 40% depending on follow-up duration and surgical method [20,24, 25,34]. Large registry-based studies such as the IRIS Registry have reported 5-year reoperation rates of approximately 20%, reflecting real-world outcomes across diverse clinical settings and surgical techniques [1,22]. These findings highlight that, even with standardized surgical planning, some degree of exodrift and recurrence is almost inevitable, particularly over longer follow-up periods.

When comparing surgical techniques, the literature shows some variability. The Pediatric Eye Disease Investigator Group (PEDIG) randomized trial did not demonstrate a statistically significant difference between BLR and unilateral recession–resection (RR) for basic-type IXT at three years, although a trend toward lower recurrence with RR was noted [21]. Retrospective and long-term cohort studies suggest that unilateral RR, particularly augmented RR, may be associated with lower recurrence rates compared to BLR, especially in patients with larger preoperative deviations [10,35,36]. For example, studies evaluating ‘augmented’ RR procedures have demonstrated recurrence rates as low as 7% over 2–3 years, compared to 20–25% for standard BLR or RR [25,35,37].

BLR remains a widely used technique due to its relative simplicity and safety profile, but the risk of long-term recurrence is notable. Survival analyses from long-term cohorts’ report that alignment stability after BLR may decrease progressively over time, with 5- to 10-year recurrence rates exceeding 30–50% in some series [24,36,38]. This progressive exodrift underscores the need for careful intraoperative dosing and close postoperative monitoring, as early Undercorrection is consistently identified as a strong predictor of late recurrence [27,28].

Factors beyond surgical technique also play a significant role. Larger preoperative deviations, immediate postoperative Undercorrection, older patient age, and specific sensory characteristics (such as reduced fusional reserves or poor stereopsis) have all been associated with higher risk of recurrence or reoperation [18–20,30]. Registry-based and multicentre studies have confirmed that patient-specific factors may outweigh subtle differences between surgical techniques, emphasizing the importance of individualized surgical planning [22,39].

Interestingly, some studies have highlighted the potential role of preoperative orthoptic therapy and occlusion in modifying long-term outcomes, although evidence remains inconsistent [31,33,40]. While such interventions may enhance fusional control and convergence, their ability to reduce recurrence after surgery has not been conclusively demonstrated, warranting prospective studies with standardized protocols.

Our findings fit within the broader spectrum of literature indicating that recurrence after BLR for IXT is common but can be mitigated by careful preoperative assessment, precise intraoperative alignment, and structured postoperative monitoring. Comparisons across studies reveal that, while RR may offer some advantage in long-term recurrence for select patients, BLR remains a valid and widely utilized technique. Future research should focus on refining patient selection, surgical dosage algorithms, and the potential adjunctive role of orthoptic therapies to further improve the durability of surgical outcomes in paediatric intermittent exotropia.

### **Clinical implications**

From a clinical perspective, these findings underscore the critical role of precise preoperative measurement and immediate postoperative alignment. Achieving near-orthotropia or slight overcorrection within the first postoperative week appears to minimize long-term drift and reoperation risk. Early recognition of suboptimal alignment should prompt closer follow-up and potentially adjunctive therapy to enhance fusion control.

Furthermore, identifying children at higher risk for recurrence – such as those with large preoperative deviations or older age at surgery – can guide personalized surgical planning and counselling for families regarding prognosis and long-term expectations.

### **Limitations and futures perspectives**

First, the retrospective design inherently restricts causal inference and is subject to documentation bias and unmeasured confounders [30]. Although multivariable modeling was applied to control for confounders, residual bias cannot be excluded. A prospective cohort or randomized design would provide stronger evidence for causal relationships between perioperative factors and reoperation risk.

Second, the study was conducted at a single tertiary institution, which may limit generalizability. Differences in surgical technique, postoperative management, and patient demographics across centres could influence outcomes. Multi-centre collaboration and external validation are needed to confirm these findings in broader clinical settings.

Third, despite robust statistical methods, the study may be underpowered for small subgroups, such as patients receiving orthoptic or occlusion therapy. The relatively low reoperation frequency (11%) limits statistical precision for less common predictors. Future studies with larger samples or pooled datasets could overcome this limitation.

Fourth, only motor outcomes (alignment and deviation angle) were analysed. Functional outcomes—such as stereopsis recovery, fusion maintenance, and quality of life—were not included. These parameters are increasingly recognized as essential in evaluating strabismus management, particularly in the paediatric population [26,30]. Incorporating both motor and sensory endpoints in future research would provide a more comprehensive view of surgical success.

Finally, follow-up duration was limited to 5 years, though recurrence beyond this interval remains possible. Longer longitudinal monitoring could better characterize the natural course of alignment stability after BLR recession.

Future research should therefore focus on prospective, multicentre studies combining objective motor, sensory, and psychosocial outcomes, potentially incorporating digital eye-tracking or binocular control assessment tools. Such approaches could enable individualized prediction models for postoperative outcomes in paediatric IXT.

### **Conclusions**

In this cohort of children with intermittent exotropia who underwent bilateral lateral rectus recession, larger preoperative and immediate postoperative deviation angles and older patient age were independently associated with the risk of reoperation. Initial surgical success and good early alignment were strongly protective.

These findings highlight the importance of meticulous surgical planning, accurate intraoperative alignment targets, and careful long-term follow-up. Identifying modifiable perioperative factors may help refine surgical strategies and improve long-term stability in paediatric intermittent exotropia.

### **Acknowledgments**

PML designed the study with the assistance and supervision of PA and JPC. PML collected the data and analysed it under the guidance and supervision of PA and JPC. PA supervised the methodology and statistical procedures. JPC provided methodological supervision and guidance on the analysis of results with a focus on clinical research.

### **Authors contributions**

CRediT: **Pedro Lino**: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft; **Pedro Aguiar**: Conceptualization, Data curation, Formal analysis, Supervision, Validation, Writing – review & editing; **João Paulo Cunha**: Conceptualization, Supervision, Validation, Writing – review & editing.

## Permission for publication

The author grants permission for the publication of this article.

## Disclosure statement

The authors declare no conflict of interest regarding this study/article.

## Funding statement

This research was funded by Fundação para a Ciência e Tecnologia (FCT, Portugal) through national funds to the Associated Laboratory in Translation and Innovation Towards Global Health REAL (LA/P/0117/2020).

## Data availability

The data that support the findings of this study are not publicly available due to privacy and ethical restrictions. However, they are available from the corresponding author upon reasonable request and subject to approval by the ethics committee of Hospital CUF Cascais.

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