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Conventional *vs.* hangback technique in bilateral lateral rectus recession for basic intermittent exotropia: a retrospective study in Indonesian tertiary eye hospitals

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ABSTRACT

BACKGROUND AND OBJECTIVE: Two techniques of bilateral lateral rectus recession (conventional BLR) are commonly used: conventional BLR and BLR with a hangback suture technique. Despite the advantages of the hang back technique, such as better surgical exposure and lesser risk of scleral perforation, this technique has been criticized for under-correction. This study aimed to assess the surgical outcomes of conventional BLR and BLR with a hangback suture technique in patients with basic intermittent exotropia (IXT) in tertiary eye hospitals in Indonesia.

MATERIAL AND METHODS: The medical records of those who underwent conventional BLR surgery for basic IXT between January 2016 and December 2022 in two Jakarta Eye Center (JEC) hospitals were retrospectively reviewed. The success rate and post-surgery complications after 6 months of follow-up were the outcomes measured. Success was defined as a deviation angle of ≤ 10 prism diopters at a distance and near without overcorrection or under-correction.

RESULTS: A total of 91 patients were reviewed: 66 in the conventional group and 25 in the hangback group. The median age at surgery, median preoperative deviation near and far, median amount of lateral rectus muscle recession, and median follow-up duration were not statistically significantly different between groups. After 6 months, the success rate was slightly higher in the conventional group (89.4%) compared to the hangback group (84%) albeit not statistically significant ($p = 0.481$). Recurrence and overcorrection rates were also not significantly different between the two groups ($p = 0.347$ and $p = 0.536$, respectively).

CONCLUSION: Conventional BLR technique and hangback BLR were similarly effective in the treatment of basic intermittent exotropia.

KEY WORDS: basic intermittent exotropia; bilateral lateral rectus recession conventional; hangback technique; surgical outcomes

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INTRODUCTION

Conventional bilateral lateral rectus recession (conventional BLR) and bilateral lateral rectus recession hangback (BLRH) are two commonly used surgical techniques for correcting exotropia. Conventional BLR involves a calculated retroposition of the lateral muscles by detaching the muscles from their attachment to the sclera in order to be

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reattached closer to their origin, resulting in muscle laxity. While the BLRH procedure involves tying a central locking knot in the muscle at its insertion and two locking sutures at the margins, the tendon of insertion is severed from the sclera and placed into the tendon stump instead. Thus, the muscle is weakened by suspending it posterior to the scleral insertion using sutures, creating a "pulley" effect.

The choice between conventional BLR and BLRH remains a topic of ongoing debate among ophthalmologists and strabismus specialists, as both techniques have unique advantages and disadvantages. While conventional BLR has been widely used for many years, BLRH has gained popularity due to its potential advantages, such as reducing scleral perforation [1–3], shorter operating durations [4, 5], and better surgical exposure [4]. However, several limitations of BLRH have been described, including overcorrection due to posterior bowing of the rectus muscle [6] and potential under-correction due to a more anterior attachment of the muscles to the globe [7].

This retrospective study aims to investigate and compare the surgical outcomes of conventional BLR and BLRH in patients with basic intermittent exotropia (IXT) in tertiary eye hospitals in Indonesia. To the best of our knowledge, this study is the first to compare the two techniques in managing basic IXT.

MATERIAL AND METHODS

This study is a retrospective comparative analysis of two surgical techniques, conventional BLR and BLRH, in patients with basic IXT. It was conducted at two tertiary eye care centers in Jakarta, the Jakarta Eye Center (JEC) Menteng and Kedoya. Data from patient medical records were collected and analyzed retrospectively. The study was approved by the institutional review board and adhered to the principles of the Declaration of Helsinki.

The study included patients who underwent either conventional BLR or BLRH for basic IXT between January 2016 and December 2022. The diagnosis of basic IXT was made based on clinical examination, including measurements of ocular alignment, cover-uncover testing, and prism cover testing. Patients with other forms of strabismus, previous strabismus surgery, incomplete medical records, or were lost to follow-ups were excluded from the study. Data collected were age on surgery, gender, amblyopia, follow-up duration, and preoperative ocular alignment measurements. Postoperative data, including postoperative deviation measurements at postoperative 1 week, 1 month, 2 months, 6 months were collected.

The primary outcome measures were surgical success, recurrence, and overcorrection rates. Success was determined as a deviation angle of ≤ 10 prism dioptre (PD) at a distance and close, without over- or under-correction.(8)Recurrence or under-correction is defined as a distance fixation of >10 PD exophoria/-tropia, whereas overcorrection is defined as a distance fixation of > 5 PD esophoria/-tropia [8]. Secondary outcome measures included exploring possible pre-operative and operative factors that could affect the success rates.

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as means with standard deviations or medians with interquartile ranges, as appropriate. The surgical success rates were compared between the conventional BLR and BLRH groups using chi-square test. Binomial univariate and multivariate logistic regression were performed to explore the factors that could affect the surgical success rate. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA).

RESULTS

The demographics of patients with basic IXT included in the present study are summarized in Table 1. This study included 66 patients who underwent conventional BLR and 25 who underwent BLRH. The gender distribution was similar between the two groups, with 56.1% males in the conventionaly-treated group and 40% males in the hang-back group ($p = 0.171$). The majority of patients in both groups had poor fusion control (68.2% in conventional group and 76% in hang-back group), with no statistically significant difference between the groups ($p = 0.361$). Most patients in both groups had onset-surgery duration greater than 7 days (62.1% in conventional group and 60% in hang-back group) and no amblyopia (97% in conventional group and 96% in hang-back group), with no statistically significant differences between the groups ($p = 0.729$ and $p = 0.817$, respectively). The median age of surgery was 14 years

Table 1. Demographics of the basic intermittent exotropia (IXT) patients enrolled in the study

Variables	Conventional (n = 66), N (%)	Hang-back (n= 25), N (%)	p
Sex			0.171
Male	37 (56.1)	10 (40)	
Female	29 (43.9)	15 (60)	
Fusion control			0.361
N/A	13 (19.7)	2 (8)	
Good	0 (0)	0 (0)	
Fair	6 (9.1)	4 (16)	
Poor	45 (68.2)	19 (76)	
Fair to poor	2 (3)	0 (0)	
Onset-surgery duration			0.729
N/A	41 (62.1)	15 (60)	
≤ 7	16 (24.2)	5 (20)	
> 7	9 (13.6)	5 (20)	
Amblyopia			0.817
Yes	2 (3)	1 (4)	
No	64 (97)	24 (96)	
Age of surgery, median (range)	14 (3-38)	14 (3-57)	0.455

N/A — not available

in both groups, with no statistically significant difference (p = 0.455).

Table 2 outlines the preoperative features, duration of follow-up, and surgical outcomes, such as the success, recurrence, and overcorrection rates. There was no significant difference between the groups regarding preoperative deviation, amount of recession, or postoperative follow-up time. The success rate was higher for the conventional group at 89.4% as compared to 84% for the hangback group, although this difference was not statistically significant. Similarly, the recurrence rate was lower for the conventional group at 9.1% as compared to 16% for the hangback group, but this difference was also not statistically significant. Only one patient in the conventional group experienced overcorrection, while no patient in the hangback group experienced overcorrection.

Figure 1 depicts the changes in success rates for both groups across multiple time periods. Postoperative time points included were 1 week, 1 month, 2 months, and 6 months. Although there were no statistically significant differences across all time points (p > 0.05), the conventional BLR functioned better at the 1-week and 1-month time points, and the BLRH performed better thereafter. However, these results should be interpreted with caution due to the gross amount of missing data at subsequent time points.

To account for baseline variations in age, preoperative deviation, amount of recession, and length of follow-up, an adjusted odds ratio (using con-

Table 2. Preoperative characteristics and surgical outcomes

Variables	Conventional (n = 66)	Hang-back (n = 25)	p
Preoperative deviation in PD, median (range)	45 (15–65)	45 (25–50)	0.876
Amount of LR recession in [cm], median (range)	9 (4–10)	9 (6–9)	0.894
Postoperative follow-ups in [weeks], median (range)	60 (5–1281)	60 (6–463)	0.56
Success rate, N (%)	59 (89.4)	21 (84)	0.481
Recurrence rate, N (%)	6 (9.1)	4 (16)	0.347
Overcorrection rate, N (%)	1 (1.5)	0 (0)	0.536

PD — prism dioptre; LR — lateral rectus

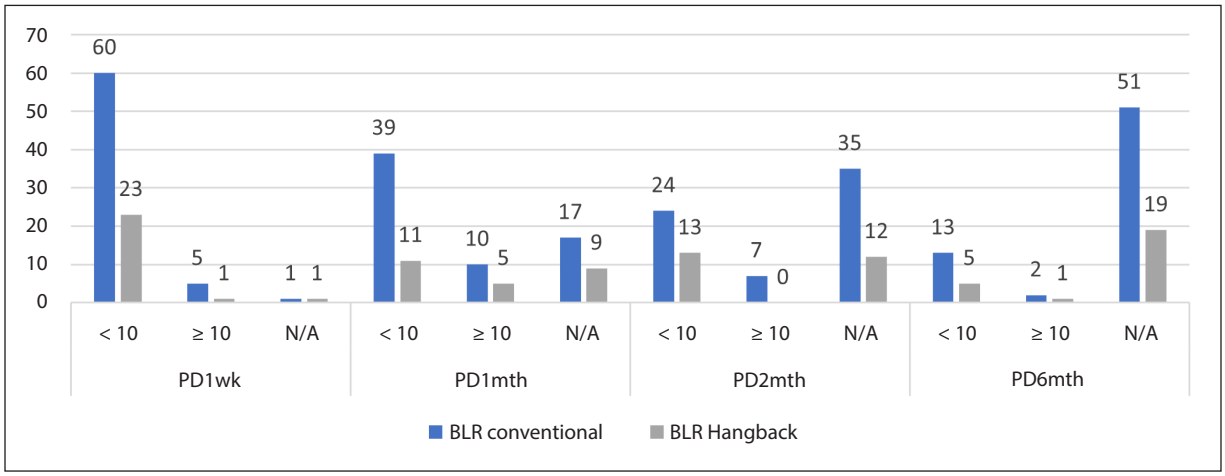

FIGURE 1. Post-operative prism dioptre (PD) of both groups at different time points. 1wk — 1 week; 1mth — 1 month; 2mth — 2 months; 6mth — 6 months; N/A — not available; BLR — bilateral rectus recession

Table 3. Univariate and multivariate logistic regression models of possible factors affecting the success rate of both surgeries

Variables	OR (95% CI)	p
Univariate		
Surgery (conventional *vs.* hangback)	0.623 (0.165, 2.345)	0.484
Multivariate		
Surgery (conventional *vs.* hangback)	0.466 (0.112, 1.944)	0.295
Age (1 year increase)	0.943 (0.859, 1.035)	0.214
Preoperative deviation (1 PD increase)	1.043 (0.898, 1.211)	0.585
Amount of recession (0.1 mm increase)	1.152 (0.232, 5.723)	0.862
Length of follow-up (1 week increase)	1.002 (0.999, 1.005)	0.297

OR — odds ratio; CI — confidence interval; PD — prism dioptre

ventional surgery as the reference) for surgical success at the last follow-up was calculated (Tab. 3). The results of the univariate and multivariate analysis revealed that the type of surgery (conventional *vs* hangback) was not significantly associated with the postoperative alignment outcomes, with an odds ratio (OR) of 0.623 [95% confidence interval (CI): 0.165–2.345, p = 0.484] and OR of 0.466 (95% CI: 0.112–1.944, p = 0.295), respectively. Similarly, other variables such as age (OR: 0.943, 95% CI: 0.859–1.035, p = 0.214), preoperative deviation (OR: 1.043, 95% CI: 0.898–1.211, p = 0.585), amount of recession (OR: 1.152, 95% CI: 0.232–5.723, p = 0.862), and length of follow-up (OR: 1.002, 95% CI: 0.999–1.005, p = 0.297) did not show significant associations with the postoperative alignment outcomes. These findings suggest that while conventional BLR and BLRH techniques may show some differences in the success rates, these differences were not statistically significant after controlling for other variables in the univariate and multivariate analysis.

DISCUSSION

We reported no difference in the success rate between individuals who underwent conventional BLR and BLRH; the hang-back approach appears to be at least as successful as the conventional lateral rectus recession in this small, nonrandomized patient series.

Other studies comparing conventional BLR and BLRH for exotropia have also reported no significant difference in the surgical success rate (≤ 10 PD of deviation) between the two types of surgeries [4, 9, 10]. However, there are other studies that reported otherwise. A study by Mohan et al. [11] observed a significant difference between conven-

tional BLR and BLRH in terms of success rate (≤ 10 PD of deviation) for true divergence excess IXT (82.8% *vs.* 30.8% respectively, p = 0.0009). Furthermore, a study by Capo et al. (6)also reported a greater success rate (≤ 8 PD of deviation) for conventional BLR as compared to BLRH in patients with intermittent or constant exotropia (85% *vs.* 64%, p< 0.05) which they attributed mainly to more late overcorrections occurring in the BLRH group (5% *vs.* 27%), probably as a result of posterior bowing of the rectus muscle. To the best of our knowledge, the present study is the first to compare the two techniques, specifically on intermittent basic exotropia.

Based on our experience, BLRH seemed safer and preferred for cases with significant deviation, necessitating a larger recession. With a larger recession (± 8 mm), the surgical field is narrower, and hence, maintaining parallelism of the spatulated needle to the sclera during muscle reattachment is rather challenging. There is a possible risk of perforation if the suture is placed too deep in the sclera and muscle loss or slippage if it is too superficial. Olsen et al. [12] discovered that the sclera is thinnest, 13–15 mm posterior to the limbus and less thin around the insertions of the rectus muscle, five to eight millimeters posterior to the limbus. Given that in conventional BLR, the attachment of the new insertion is to the sclera, and the risk of scleral perforation increases with decreasing sclera thickness [1], it appears that attachment of new insertion to the tendon stump seems safer. This aligns with reports from other studies that observed a higher risk of scleral perforation during muscle reattachment to the sclera [1–3].

Although not examined in this study, another possible advantage of BLRH compared to conventional BLR is the shorter duration of anesthesia. Rajavi et al. reported a mean of 32 ± 5 minutes to perform BLRH compared to 40 ± 5 minutes to perform conventional BLR. This could be more beneficial in settings where healthcare resources are scarce. In addition, changes in corneal curvature have been reported to be less in BLRH as compared to conventional BLR, which could reduce amounts of induced astigmatism immediately post-operatively [13].

An interesting observation in this study was that the under-correction rate is lower in the BLRH group than in the conventional BLR group. This result differs from previous studies, which reported muscle creeping post-hangback recession, causing undercorrections. Mills et al. discovered a 2 mm forward migration of the rectus muscle 2 years following a 5 mm hang-back recession in an undercorrected patient [14]. In addition, Ohtsuki et al. also reported a substantially larger mean forward creep with hang-back recession than with conventional recession (1.81 mm *vs.* 0.50 mm) [15]. However, there are several studies reporting no differences in muscle creeping between the two techniques [7, 16]. Although none of the patients with undercorrections was re-explored, this phenomenon is worth investigating. Hence, further examination of this issue could develop insight into the position of muscles post-hangback recessions.

Randomization of the surgical approach and baseline standardization were not performed given the nature of the study, and thus, there were inherent baseline differences in the two groups, especially the number of people in each group; the hangback group was approximately one-third smaller as compared to the conventional group, and this could possibly affect the generalizability of the outcomes. After adjusting for several baseline data, including the age of surgery, preoperative deviation, amount of recession, and duration of follow-up, we found that the differences in the success rates were not associated with these factors. Univariate and multivariate analyses also showed that the success rate was not associated with the type of surgeries performed.

This study has several limitations, including its retrospective design, which may be subject to selection bias and confounding factors such as complications. The sample size may also be limited, depending on the number of eligible patients and available data. Additionally, the study may be limited by the quality and completeness of the medical records, as well as potential variations in surgical techniques and surgeon experience. Despite these limitations, this retrospective study may provide valuable insights into the comparative outcomes of conventional BLR and BLRH in patients with basic IXT, but further prospective studies with larger sample sizes are warranted to confirm the findings.

CONCLUSIONS

The objective of this retrospective study was to assess the efficacy of conventional BLR and BLRH procedures in patients with basic IXT in tertiary

eye hospitals in Indonesia. The results of this study indicate that there were no statistically significant differences between conventional BLR and BLRH procedures in terms of postoperative deviation outcomes at any time point following surgery. Therefore, both techniques are viable alternatives for the correction of fundamental IXT. However, BLRH may offer some potential benefits, including improved maneuverability in larger recessions, a shorter anesthesia duration, and an immediate reduction in astigmatism. Ultimately, the decision between conventional BLR and BLRH should be made case-by-case, taking into account the nuances of each technique and the needs of the individual patient.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality and privacy concerns. Still, they are available from the corresponding author on reasonable request. Any data shared will be de-identified to protect patient privacy in accordance with ethical guidelines.

Ethics statement

This study was conducted in accordance with the ethical standards set forth by the Declaration of Helsinki and was approved by the institutional review board. Informed consent was obtained from all patients or their guardians for the use of their medical records for research purposes. The confidentiality and anonymity of all patient data were strictly maintained throughout the study. The research posed minimal risk to participants, and the benefits of the study outweighed any potential risks.

Author contributions

D.N.A contributed to the conception and design of the study, coordinated the data collection process at the Jakarta Eye Center (JEC) Menteng, and wrote the initial draft of the manuscript.

G.G.S. provided critical revisions to the manuscript for important intellectual content, assisted in the interpretation of the data, and supervised the overall research project.

E.T. managed the data collection at the Jakarta Eye Center (JEC) Kedoya, performed the statistical analysis, and contributed to the interpretation of the data.

All authors have read and approved the final version of the manuscript.

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Conflict of interest

The authors report no conflict of interest.

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